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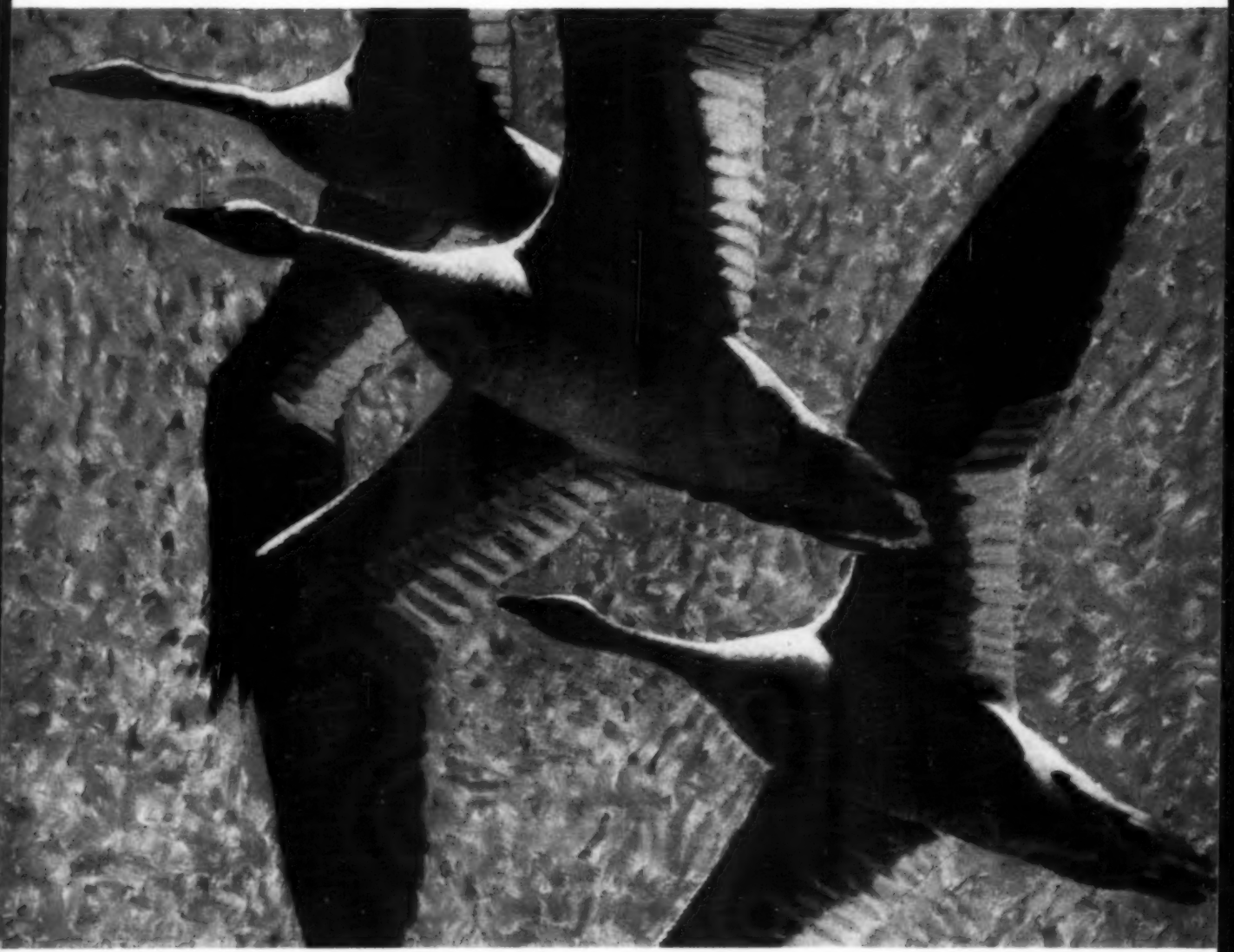

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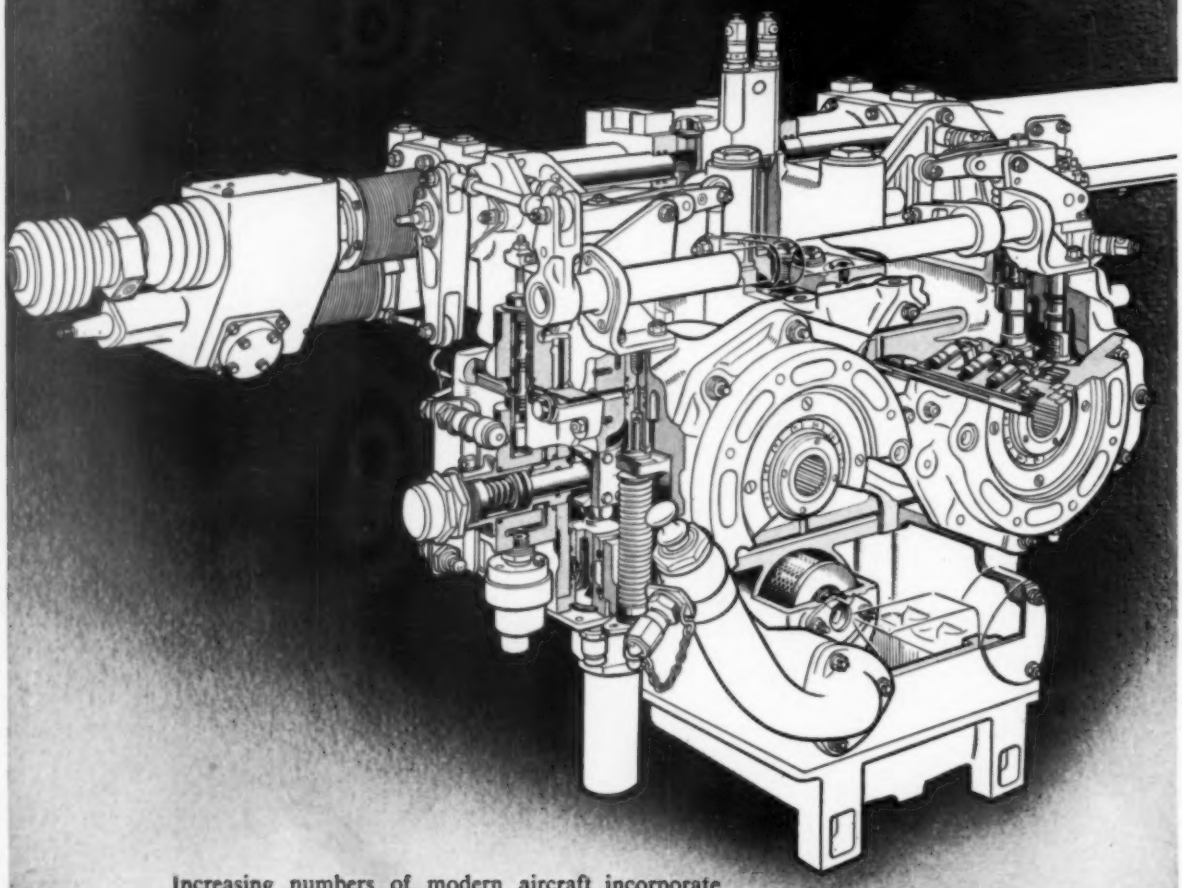

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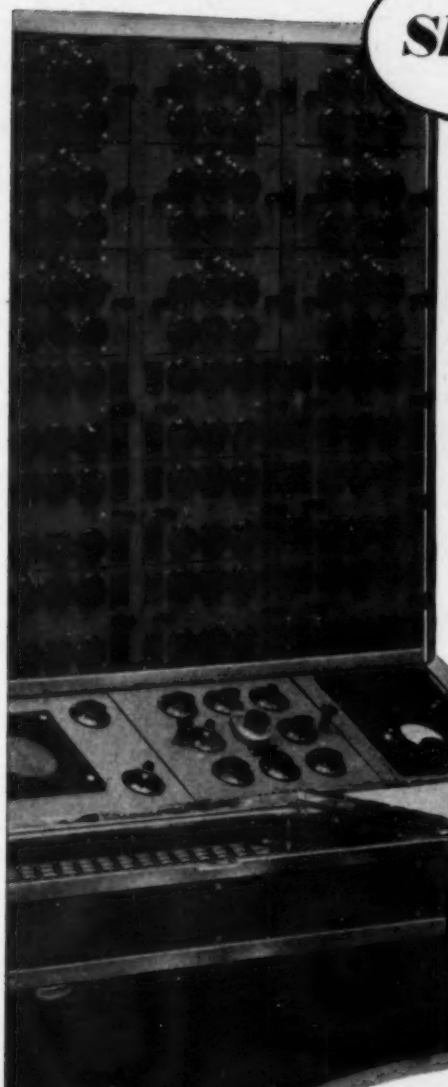

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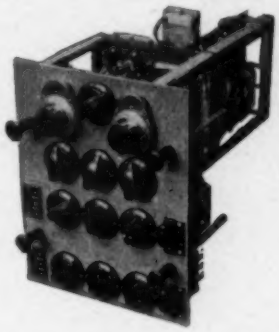

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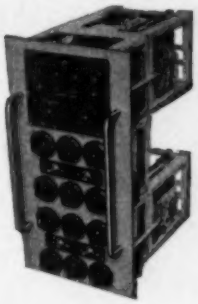

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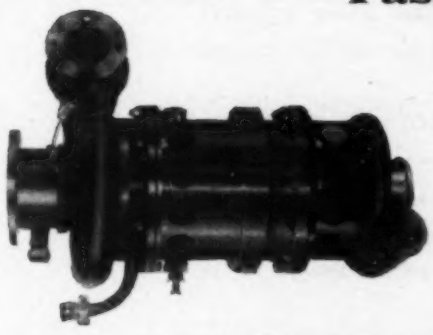

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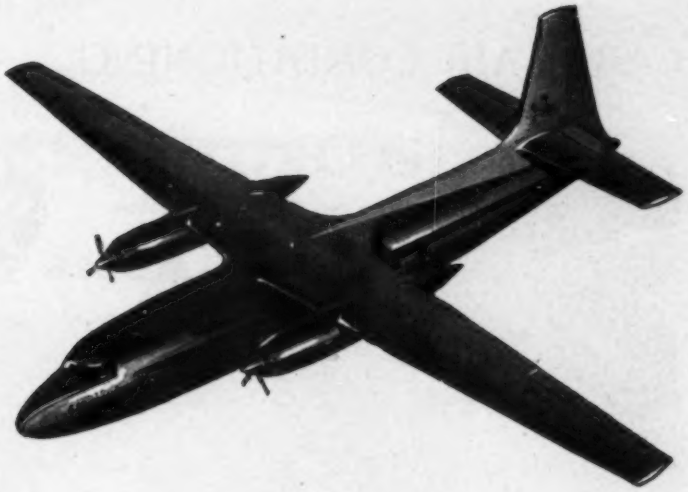

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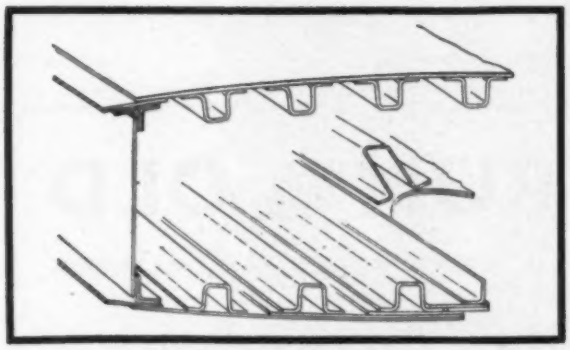

Tests conducted for a period of several years by the Royal Netherlands Aircraft Company Fokker in co-operation with the National Research Laboratory (N.L.L.) have confirmed the superiority of 'Redux' for the bonding of components such as these, where the demands of variable loading and climatic conditions must be fulfilled.

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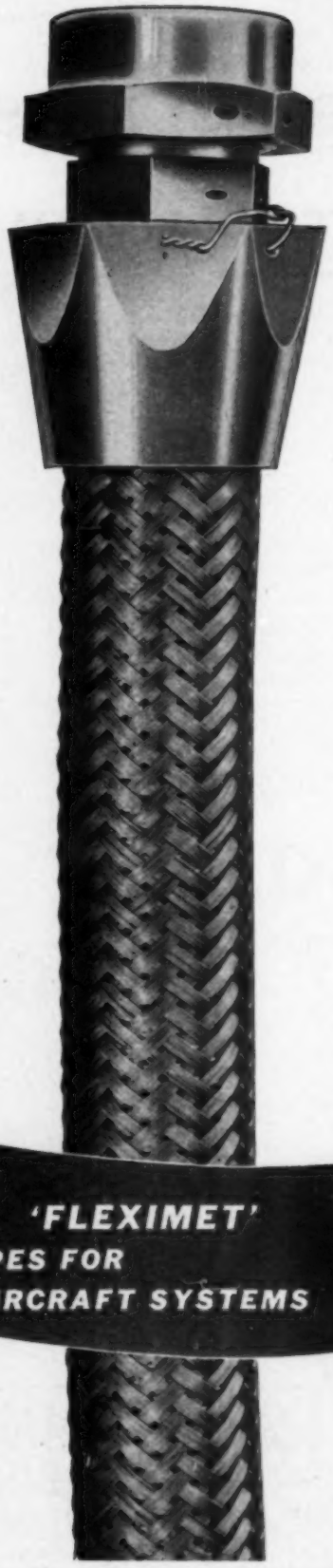

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and
AIRCRAFT ENGINEER

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MAURICE A. SMITH D.F.C. AND BAR

Editor
H. F. KING M.B.E.

Technical Editor
W. T. GUNSTON

Production Editor
ROY CASEY

Iliffe and Sons Ltd.
Dorset House
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Telephone · Waterloo 3333
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To Chief Marshal of Aviation P. F. Zhigarev

DEAR MARSHAL ZHIGAREV, You will not, I believe, consider it impertinent that I address this letter to you personally; for you, as chief of the vast Soviet Aeroflot, and *Flight*, as a journal concerned with world aviation, share a common interest. That interest, you will agree, can best be served by the same frankness and cordiality that marked your recent talks with British European Airways.

The thought occurred to me a few evenings ago, during a reception at the Soviet Embassy here in London. (You will recall a party there just before Christmas, when, with members of your staff, you were able to chat informally with B.E.A. colleagues.)

The recent occasion was in celebration of the 40th anniversary of the Soviet Armed Forces; but I was glad to see that civil aviation was prominently represented. In particular, I noticed our friend "Bill" Simpson, who is chief of B.E.A.'s public relations branch. His presence reminded me that, whatever Aeroflot and B.E.A. have to learn from each other, our British airline is the more widely experienced in disseminating information on its equipment and activities to the Press and public.

There are people in this country who find this a little difficult to understand, always having regarded the Russians as a nation of propagandists. But as we have previously remarked in *Flight*, it would seem that the Russians themselves prefer their aeroplanes to do their own talking—through the medium of the publication *Records Officiels Homologués*, issued by the Fédération Aéronautique Internationale. It will not be necessary to remind you, sir, that aircraft on order for Aeroflot make an impressive showing in that august publication.

There are others in Great Britain who, from personal or political motives, refuse to admit that any technical information of any value whatever finds its way out of Russia. This, of course, is a gross misrepresentation—as the sectional drawing of your magnificent Tu-114 bore witness in these pages last week.

The pity is that data on new Soviet transport aircraft are being received from such diverse sources and through such divergent channels that reliability is often in question and completeness is seldom satisfying. Seeking to remedy these deficiencies we of *Flight* have on several occasions solicited full and authentic data by addressing verbal and written requests to Soviet officials in London and Moscow (among them a letter—in what we faithfully believed to be the Russian language!—to you, sir, yourself).

That these requests were fruitless signified, we are certain, neither discourtesy nor reticence; and it is in the hope that our purpose may yet be achieved that we reiterate our desire for complete and up-to-date descriptive material on the latest Aeroflot aircraft. Whether this should emanate from a department of Aeroflot itself, from the designers of the aircraft concerned, or be collected at first hand by *Flight* writers and artists, must be for you or your staff to decide.

We seek no military or commercial secrets; nor do we hope to cajole you into premature disclosures while the aircraft are still under development. But we do seek to acquaint our readers in all countries of the world with the characteristics of what we know to be very fine aeroplanes—aeroplanes which, we hope, will be increasingly seen beyond Soviet frontiers in the years ahead.

Your favourable attention to this matter would, I am confident, be a real contribution toward international understanding.

With every assurance of esteem, and with all good wishes for the prosperity of your great airline, I am, Sir,

Yours faithfully,

THE EDITOR.

FROM ALL QUARTERS

M.o.S. and the Comet

QUESTIONS were asked in the House of Commons last week about the number of Comet 1s and Comet 2s bought by the Ministry of Supply. The Parliamentary Secretary to the Ministry, Mr. W. J. Taylor, told the questioner, Mr. Frank Beswick (Lab., Uxbridge), that three Comet 1s were purchased as prototypes in aid of development of the type, and eight Comets had been bought for M.o.S. research, the majority being used for ground fatigue-tests. Two Comet 2s, he said, were purchased for military development, one of these being for ground fatigue-tests. Thirteen Comet 2s had been purchased for the R.A.F. In addition, the Ministry had bought three airframes for disposal. The cost of these 29 aircraft, excluding engines, was rather more than £9 million.

Pressed by Mr. Beswick to agree that these purchases were made to help de Havilland out of financial difficulties, Mr. Taylor replied: "I do not accept that more aircraft were bought than were necessary. With regard to [financial] rescue operations . . . that was fully dealt with in the report of the Controller and Auditor-General, 1954-1955, and later by the Committee on Public Accounts for the session 1956."

Presumably the three "prototype" Comet 1s referred to by Mr. W. J. Taylor were Comets 01, 02 and 06 (the last being the Series 2X, fitted with Rolls-Royce Avon engines). The other eight Comet 1s were no doubt those operated by B.O.A.C. and Air France.

Mr. Taylor's reply about the number of Comet 2s ordered for the R.A.F.—13—is the first official reference to the fact that the R.A.F. operates three Comet 2s in addition to the ten operated by No. 216 Squadron, Transport Command. These three additional Comet 2s are used by No. 90 Group for special duties.

Tissandier Diplomas

FOUR members of the Royal Aero Club have been awarded Paul Tissandier diplomas by the Fédération Aéronautique Internationale. Mr. S. Kenneth Davies receives one for his work as R.Ae.C. vice-chairman (1948-52), for his chairmanship from 1952 to the present date and also for his chairmanship of the Welsh Advisory Council for Civil Aviation; Mr. D. J. Lyons for his work as chief handicapper to the Royal Aero Club at all its National Air Races during the past ten years; Mr. Peter Masefield for his contribution to private aviation over a number of years, especially as president of the Popular Flying Association; and Mr. F. N. Slingsby for his work in connection with the design and production of sailplanes and gliders in Great Britain.

The diplomas are to be presented in Los Angeles on April 14 at the annual general conference of the Fédération Aéronautique Internationale, which Mr. Davies is attending. Mr. Slingsby also hopes to be there.

DART HERALD: A well-kept secret at Woodley for the past eight months has been progress with the conversion of the prototype to Rolls-Royce Dart power. Here, rolled out last week on schedule, is the completed aircraft almost ready for tests *(see also p. 320).*

"Flight" photograph

Anniversary Air Races

AN increased number of entries will be permitted in each class race at this year's National Air Race meeting at Baginton on July 10-12, which celebrates the tenth anniversary of these races. There will be 14 entries each in races for the Kemsley, Osram and Goodyear Trophies; while for the fastest average speeds over the three rounds of these races the Air League, Norton Griffiths and Grosvenor challenge cups will be awarded.

King's Cup competitors will consist of the first seven pilots (of British aircraft) in each of the above class races, and the S.B.A.C. Cup will go to the pilot making the highest speed over the King's Cup course. The British Lockheed International Aerobatic Competition will follow last year's lines, and the closing date for all events is Monday, June 9.

B-47 Destroyed by Drop-tank

A U.S.A.F. B-47 was destroyed by fire at Greenham Common airfield near Newbury, Berks, on February 28 after it had been hit by a drop-tank jettisoned by another B-47. Two U.S. airmen died as a result of injuries received in fighting the fire and a hangar hit by another tank was severely damaged.

U.S.A.F. headquarters at Ruislip said that the jettisoned tanks had fallen on the drop range but had ricochetted. The aircraft, which had reported engine trouble, landed safely at Brize Norton, Oxon. On March 3 a Brize Norton-based B-47 dropped a single, empty tank on an orchard at Ashton Keynes, Wilts. Holding 1,780 U.S. gal each, these are the largest drop-tanks in the world.

Charter-flight Tragedy

WITH much regret *Flight* records the accident to Silver City's Bristol Freighter 21 G-AICS, near Horwich, Lancashire, on Thursday of last week. Of the 42 people on board, 35 lost their lives; the survivors included the captain, co-pilot and stewardess.

The accident was the first involving injury or death ever suffered by Silver City in 12 years of operations, during which time 1,500,000 passengers had been carried. The aircraft was on a charter flight from the Isle of Man to Manchester with a party

R.Ae.S. HEARS ITS PRESIDENT: Sir George Edwards delivered his presidential address—summarized on p. 307—to the Royal Aeronautical Society at Church House, Westminster, last week. Below, at left, Lord Hives (the chairman) is seen opening the proceedings, and at centre Dr. G. W. H. Gardner (R.Ae.S. council member) proposes a vote of thanks to Sir George Edwards. In the remaining pictures the scene moves to the subsequent reception at Hamilton Place. Sir George and Lady Edwards are welcoming Air Marshal Sir Geoffrey Tuttle, Deputy Chief of the Air Staff; and the small photographs portray Sir William Farren, Mr. E. T. Jones (last year's president) and Sir Roy Fedden.

"Flight" photographs

"Flight" photograph

of Manx businessmen, most of them in the island's motor trade.

A public inquiry has been ordered by the Minister of Transport. In the meantime Mr. Eoin Mekie, chairman of British Aviation Services Group, of which Silver City is a member, has said there appears to be no reason to suspect technical malfunctioning.

FBMS Accelerates

SUCCESSIVE injections of money (some $400m in supplementary appropriations) have accelerated the progress of the U.S. Navy's Fleet Ballistic Missile System. The weapon portion of this system is Polaris, described in our December 6 missile review issue. Recent design changes have made Polaris a two-stage weapon and have reduced its overall length to barely 30ft, The design range is 1,500 miles, but the warhead is smaller than that of the land-based IRBMs.

Specifications recently announced for the FBMS carrier vehicle —a new class of large nuclear-powered submarine carrying 16 Polaris—include: submerged displacement, 5,600 tons; length, 380ft; beam, 33ft; estimated cost, $105/110m for the first ship and $85/90m thereafter. Contracts have been placed with the Electric Boat division of General Dynamics and Mare Island Navy Yard. All parts of the FBMS may be operational by 1960.

504 Club's Seventh Reunion

ALTHOUGH the seventh annual reunion dinner of the Avro 504 Club was the first at which "A.V." was no longer present, it was the same typically happy, reminiscent occasion. Until his death at the age of 80 last January, Sir Alliott Verdon-Roe retained all the boyish enthusiasm of the young man who, in 1908, had been the first to construct and fly a British-built aeroplane. The members of the club, which owes its existence to him, are happy to remember him in that way.

This year's dinner took place at Londonderry House last Friday. After an introduction to the evening and the speakers by Mr. "Joe" Taylor, Mr. H. Norwood proposed the toast of the Avro company, tracing aspects of its development in a clear and interesting manner. He recalled the time when there were only 120 on the payroll; now there were 120,000, though only 30 per cent of them were directly concerned with aircraft.

Replying, Sir Roy Dobson (managing director) spoke of "A.V.'s" inventive genius: it was impossible for him to be a business man, but "he invented a way round business, because his mind was so quick." Of his many inventions outside the aircraft industry, Sir Roy said that he gave them all away.

Turning to the company's prospects, Sir Roy thought there would be military aeroplanes for many years, as well as commercial and industrial ones. He doubted the wisdom of B.E.A.'s new three-jet specification, on the grounds that it needed a little more range and capacity; and he added that it was a great pity "the poor Government" could not build a big supersonic aircraft, capable of Mach 2.5 or 3. Sir Roy said his company knew how to do it, and although he would not suggest that large aircraft flying at high supersonic speeds across the Atlantic would be profit-making under existing conditions, enterprise of this kind was still desirable for reasons of national prestige. Such a project Avro could not undertake unaided.

On the subject of a possible British satellite, Sir Roy said that his company could launch one from a Vulcan at perhaps 55,000ft and so save all the trouble of the ground-launch and early stages. This again, he felt, the country ought to be allowed to do.

Remarking that, if the Hawker-Siddeley group became all-industrial, he himself would "fade out," Sir Roy said that it now needed to be 70 per cent industrial to afford the luxury of 30 per cent aviation. However, aviation itself was going on longer than any of them, and all they needed to do was work at it.

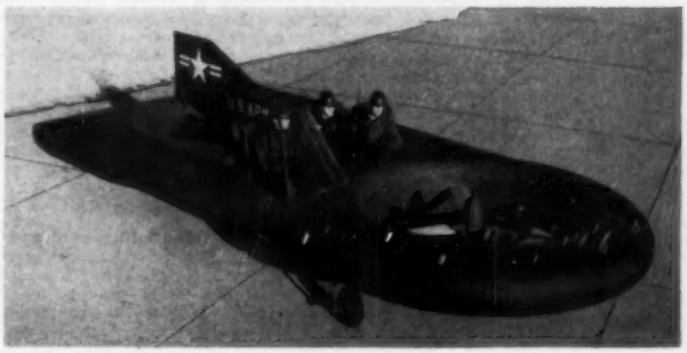
The toast of the guests was amusingly proposed by Mr. "Jock" Ratcliffe and the reply was by Mr. Geoffrey Verdon-Roe, son of "A.V." Recalling many intimate details of his father's life, he quoted from *The Aviator's Storehouse* of 1910—for example, an aircraft for sale "with span of 20 to 26ft as ordered by customer." Aero engines then cost exactly £5 per horsepower.

There were two additional speeches, of great interest, from Messrs. W. G. Norris and G. W. Halse. Mr. Norris is believed to have been the first aeroplane passenger in England; as a schoolboy, he flew with "A.V." from Lea Marshes at Easter or Whitsun (he is not sure which), 1909. His flight consisted of a series of long hops some four or five feet off the ground.

Mr. Halse was with "A.V." at Brooklands in 1908 and he remembers his extraordinary faith and tenacity while building, among other designs, his triplane. On one occasion he was most indignant that a number of people were more interested in a dead horse in a corner of the field than in his aeroplane.

It is the custom each year to make the outstanding present-day Avro apprentice a member of the club. The award this year went to Mr. William R. Chadwick (no relative of the late Roy Chadwick), who was the sixth apprentice to be so honoured. Each member of the club, incidentally, was presented with an excellent 504 model by the British Petroleum Co.

***NEW CONVERTIBLES:** The Doak X-16 VTO machine for the U.S. Army (upper of the two pictures below) is about to start static trials; its Lycoming T53 turbine drives shrouded, tilting rotors. Also for the Army is the Piasecki 59K VTO device (lower picture), with fixed-axis rotors.*



A big moment for Canadian Pacific: their first Bristol Britannia 314, on a quick pre-delivery visit to Vancouver from Bristol on February 22, is seen lined up for a ceremonial entry into C.P.A.L.'s new Britannia hangar. Watching outside are some of the 3,500 airline staff and families present: in the background is a T.C.A. Argonaut, and across the other side of Vancouver International Airport is the R.C.A.F. base.

By J. M. RAMSDEN

ILLUSTRATED WITH "FLIGHT" PHOTOGRAPHS BY THE AUTHOR

Vancouver-Return by C.P.A.L. Britannia

Canadian Pacific Prepare for Their New Fleet

INSIDE his new $1.4 million Britannia hangar at Vancouver International Airport last week the president of Canadian Pacific Airlines pressed a switch, and upon the instant the power-operated doors slid back to reveal his first Britannia 314. Immaculate in her red and white paint-scheme, and with the myriad rooflights of the hangar mirrored in her burnished bulk, C.P.A.L.'s new *Empress*-class airliner proudly made her entrance to the strains of *Rule, Britannia!* From where I stood I could just see the sousaphones of the local brass band bobbing above the intervening heads of 3,500 cheering C.P.A.L. employees and their families.

It was quite a moment for Mr. Grant McConachie, who was delightedly shaking hands with everyone in reach—Mr. Norman Crump, president of C.P.R.; Mr. Peter Masefield, managing director of Bristol Aircraft; Mr. Otto Safir, architect of the hangar; and the Mayor of Vancouver, and other civic dignitaries.

One might almost say that this moment was the fulfilment of Grant McConachie's long and unswerving championship of British transport aircraft. The Britannia concerned, CF-CZA, was the first of six 314s ordered by C.P.A.L., built on the Short Brothers and Harland "second-source" Britannia line at Belfast.

Our flight from Bristol to Vancouver had been made expressly to provide the ceremonial opening of C.P.A.L.'s new Britannia hangar with the appropriate *panache*. It was not a delivery flight or a route-proving flight; much work remains to be done before this aeroplane can be delivered—an event which Bristol hope, and C.P.A.L. expect, will take place on March 29. It was primarily a test-flight, with Shorts and Bristol men at work, and senior C.P.A.L. crews under training.

As a passenger, I was able to renew my experience of test-flying in a commodious transport, an experience with its own special mixed brand of business and mateyness. No one minds if you pass the night curled up on the floor (it's warm near the floor-level warm-air grilles), play a foursome of pontoon on the flight spares pack, or help yourself from the galley's plentiful reservoir of orange juice. But you have to keep out of the way if someone wants to press a thermocouple on your window-frame; you have to keep quiet when a decibel-level reading is being taken nearby; you do not address yourself to the normally approachable managing director of Bristol Aircraft when he is preoccupied with fuel-management calculations; and you do not loiter about the flight deck when it is crowded with pilots, navigators and engineers. (At one period during the outward flight there were 11 people in the cockpit.)

Such a flight presents boundless opportunities for learning and observing. I was keenest to learn about the implications for C.P.A.L. of introducing the Britannia, and to gather the opinions of that respected airline on the wider issues of the air transport business. But one cannot be aboard a Britannia for two non-stop journeys of about 14 hours each without realizing that the advertised claims for this airliner ("fastest, longest-range," etc.) are the simple truth.

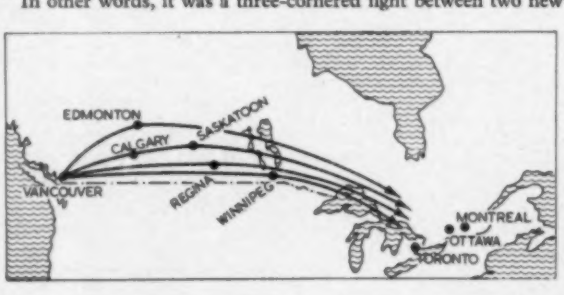
You can get as emotional as you like about a brochure, but you cannot climb aboard one in Vancouver with 36 others and be sitting in your office in London 15 hours later. To have done just that, or to have flown non-stop from New York to Tel-Aviv in an El Al Britannia, is to have crossed the deceptively wide gap which separates promises from fulfilment. Perhaps, at one time, Bristol did not appreciate how wide that gap was, or how daunting and perverse the troubles *en route* could be. But they do now; and they can show you in production a turbine airliner which works, which they guarantee will fly for 16 hours with an 18,000 lb payload at an average speed of 350 m.p.h., and which you can see, hear, touch and smell. Sales-talk, perhaps; but it needs saying now and again in a world which seems prone to intoxication by the sniff of pigskin brochure-bindings.

Canadian Pacific decided to buy Britannias on October 20, 1955, four and a half months after the inauguration of their trans-Arctic DC-6B service between Vancouver and Amsterdam, and one week after PanAm's order for 707s and DC-8s—the historic order which started the big-jet snowball rolling.

C.P.A.L. were the pioneers of the over-the-top (not quite transpolar) service, and they were going to make a big success of it. The choice of equipment, and its timing, was vital. We quote from a C.P.A.L. equipment study published when the Britannia order was placed:—

"The only aircraft offered early in 1955 for delivery early in 1957 were the piston-driven DC-7C and Lockheed's 1649A, and the Bristol Britannia turboprop 310. The Comet 4 was also considered, but later eliminated because delivery time was the critical factor."

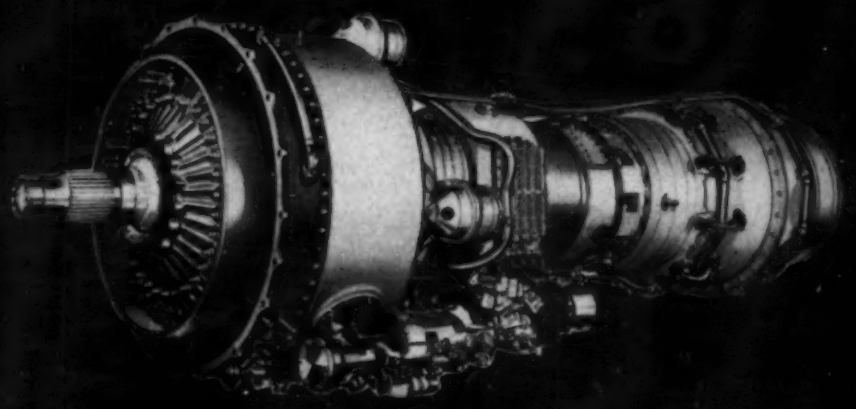
In other words, it was a three-cornered fight between two new



Upon this map, which shows very roughly the sort of transcontinental domestic services which C.P.A.L. hope to operate, depends the possibility of further orders for British transport aircraft (see text). C.P.A.L.'s present domestic routes, which currently account for only about a fifth of their total business, are confined to Convair-operated local services in the north-west. T.C.A. have had the monopoly of Canada's main domestic routes for more than 20 years.

ROLLS-ROYCE

TYNE PROP-JETS



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On the left is C.P.A.L.'s international route-system, excluding the comparatively recent additions of Santiago and Edmonton. In the photograph taken in the cockpit at 35,000ft westbound over Newfoundland are (left) Capt. Harvey Johnson, C.P.A.L.'s chief pilot, and (right) Capt. W. S. Roxborough, C.P.A.L.'s chief Britannia pilot. In command of the flight each way was Walter Gibb, Bristol's chief test pilot. Standard displays are Smiths' flight system and Bendix radar.

VANCOUVER-RETURN BY C.P.A.L. BRITANNIA...

piston-engined candidates and the Britannia. But C.P.A.L. did not overlook the big jets:—

With further development the DC-8 and Boeing 707-320 will probably be satisfactory by the time we need a jet in 1961 or 1962."

The airline's policy remains unchanged: at Vancouver I gathered that a fleet of big jets would "most certainly" be ordered this year. Opinions still differ within the airline about the relative merits of the DC-8 and 707. My impression was that the engineering executives favour the DC-8.

I asked how C.P.A.L. felt about the delay in Britannia deliveries, and the effect this had had on their plans. They are naturally disappointed, as they have been unable as yet to take bookings for this summer's schedules to Europe, starting on April 1. Their disappointment is manifested as sadness rather than soreness. They regret the lost year, but appreciate the accumulative reasons for the delay, and acknowledge Bristol's big efforts to make up time lost, due—Bristol say—to the Proteus icing problems, labour disputes, C.P.A.L.'s special change-orders, and Shorts' initial unfamiliarity with Britannia production.

"Talking equipment" to C.P.A.L. very quickly reveals the crux of their planning problems. They cannot commit themselves to anything until they know the outcome of their application to operate domestic transcontinental trunk routes across Canada. Approval of this will require a major change in Government policy, which has hitherto reserved Canada's domestic trunk services for the state-owned airline T.C.A. A political analogy in this country would be an application by Airwork or Eagle to operate the longer U.K. domestic routes in competition with B.E.A.

When Mr. Diefenbaker took office, and Canada selected the Conservatives after more than a decade of Liberal administration, C.P.A.L.'s domestic hopes were raised. The new Government expressed its agreement-in-principle with the idea of more domestic airline competition. Mr. George Hees, Minister of Transport, said: "Competition is a valuable stimulus to more efficient operation, and to the provision of better service to the public . . . I am satisfied that the gradual introduction of some measure of competition in our domestic scheduled services should not be denied, providing the changes are made with caution and on a gradual basis."

But Mr. Diefenbaker's position has recently weakened on the more fundamental issue of Canada's economy—an issue which he will put to the test in the general election later this month.

Even if the Conservatives are returned, C.P.A.L. will not move into the transcontinental business overnight. How and when they will do it may depend upon a study which the airline consultant-economist, Mr. Stephen Wheatcroft, is now preparing on behalf of Canada's Air Transport Board.

The whole affair is so delicate so far as C.P.A.L. are concerned that I found them unwilling to talk about it. But their domestic planning is worth close investigation, because upon it depends the possibility of more orders for British aircraft.

The map (previous page) shows the sort of network upon which C.P.A.L. might be planning. It is based upon impressions gained in general conversation with executives of the airline.

Realization of such routes will change C.P.A.L.'s whole future. Mr. Grant McConachie has already hinted at the possibility of buying Comets for domestic routes, but I am certain that no firm decision has yet been made. Obviously, having decided on big jets for overseas routes, he would like them to be capable of use also for domestic routes. There is resistance to a multiplicity of types (which a senior engineer described as "the quickest way of going broke I know") and there are doubts, too, whether a special jet for the projected domestic routes is justified.

Part of the Britannia's international effort might be transferred to domestic routes. This aeroplane would fit in well with the varied stages shown on the map—down to 400 miles between Vancouver and the big cities of Western Canada, and up to 1,900 miles thence to the big cities in the east. T.C.A. may use some of their international DC-8s on transcontinental domestic services, but this competition could conceivably be met by C.P.A.L.'s own international big jets.

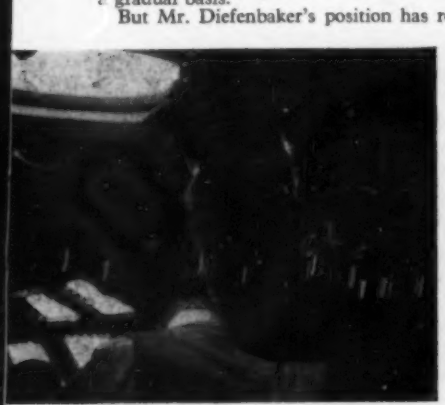
It is a dilemma within a dilemma. There is no certainty about the granting of domestic routes; and even if C.P.A.L. get them they must decide whether a special new type such as the Comet 4B is justified.

Britannias in the meantime will take over the overseas routes, the basic structure of which is an X with Vancouver in the middle. As from June 1, Britannias will displace DC-6Bs on the 4,900-st. mile Arctic route to Amsterdam. The airline's operations people are confident that the Britannia will do the eastbound service non-stop with pretty well 100 per cent regularity, knocking 5 hours off the existing 18 hour DC-6B schedule (which includes one stop at Sonderstrom). Westbound a stop may have to be made on 40 or 50 per cent of occasions, probably at Frobisher Bay.

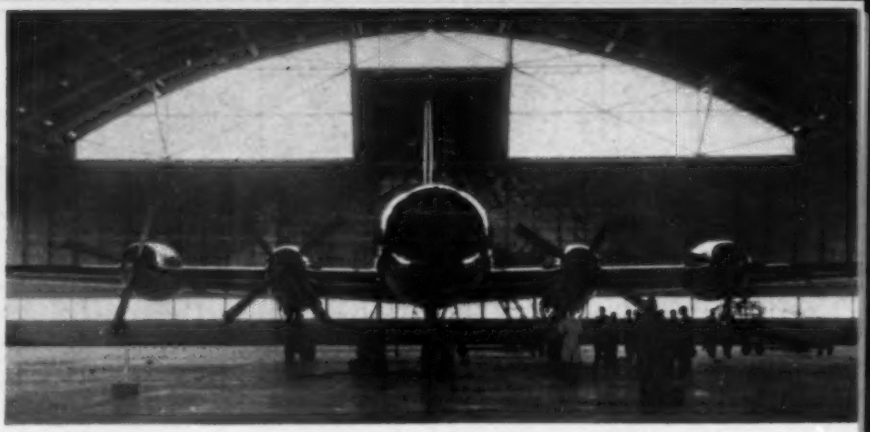
The Britannia will be a big traffic-draw, in the view of C.P.A.L.'s sales staff, who are now faced with PanAm's direct Polar service to London from Seattle (which is only a 50-minute trans-border flight away), and also the Qantas through-service from Australia to London across the U.S.A.—a new one-carrier service which may draw some of C.P.A.L.'s Europe-bound traffic originating in Australasia. And more competition will be presented by T.C.A.'s forthcoming through-service from Vancouver to London *via* Winnipeg.

Here again, C.P.A.L. are up against politics: they want traffic-rights to London. This would constitute direct overseas competition with T.C.A., the Canadian chosen instrument. It would also involve "horse-trading" with B.O.A.C., who are known to want rights into Toronto. All this complicates the central issue which, in C.P.A.L.'s view, is that Canadian traffic is being flown to the old country by Pan American.

But the Britannia will lighten these burdens: there will be no faster or more comfortable way for West Canadians to get to Europe, and of course Amsterdam is well placed for connections to



Star-tracking over the Arctic: C.P.A.L. will transplant their DC-6B polar-navigation techniques to the Britannia, using three polar-path compasses (to provide a "voting system") instead of one. Differences in C.P.A.L.'s Britannia cockpit include the skylight, and a Collins radio rack, installed—as in their DC-6Bs—along the left side. Three pilots and two navigators will be carried, together with a ground-mechanic and an electrician initially.



Canadian Pacific's first Britannia 314, CF-CZA "Empress of Buenos Aires," is seen for the first time in her specially-built new maintenance hangar at Vancouver. Two Britannias at a time can be serviced in this hangar, where the airline's maintenance-schedule will permit a service utilization rising to C.P.A.L.'s DC-6B standard — 11 hr per day. C.P.A.L.'s planned-maintenance card-index system formed the basis for Bristol's own Britannia maintenance schedule.

VANCOUVER-RETURN BY C.P.A.L. BRITANNIA ...

Europe's main cities. Seating, incidentally, will be three-class, with economy-class, tourist-class and first-class in the percentage proportions of 60:20:20. First-class seats will be by Hardman, the others (as on our flight) by Teco.

The opinion of C.P.A.L.'s vice-president of traffic, Mr. H. B. Renwick, is that eventually C.P.A.L.'s business will be dominantly economy-class and de luxe; tourist accommodation will in the meantime have to be offered on the European service because of tourist traffic coming into Vancouver from the Pacific.

Having first established Britannias on the trans-Atlantic route, C.P.A.L. will introduce them on to their Orient services to Tokyo and Hong Kong. They hope to do this in July, by which time the fleet of six will be at full strength. Delivery of the first aeroplane is due on March 29, to be followed by two in April, one in May and two in June. Britannias on the Orient service will mean that the DC-6B stop at Cold Bay, Alaska, can be skipped eastbound, and flight-time will be cut to 13 hours from 18 hours.

Next, in September, C.P.A.L.'s highly competitive Pacific route will be served by Britannias. Plans to introduce the aircraft on to the Latin-American routes are still fluid; C.P.A.L. want to avoid predictions about this until they are confident that six Britannias can—as on paper they can—do the work of the ten DC-6Bs which at present perform the whole of C.P.A.L.'s overseas routes. If traffic-growth and Britannia performance work out as anticipated, C.P.A.L. might take up their options on five more Britannias.

The DC-6B fleet will progressively displace the Convair 340s on C.P.A.L.'s local-service domestic network in north-west Canada; all five 340s may be sold in the near future. One DC-6B is already in domestic service, and four DC-6As are soon to be delivered to permit C.P.A.L. to bend more of their energies to scheduled and charter air-freighting. As passenger aeroplanes, to which they are of course quickly convertible, the DC-6As will be marketed to the public as DC-6Bs.

With six Britannias doing the international work of ten DC-6Bs, and with five other DC-6B-type aircraft available, it looks as though C.P.A.L. may have some surplus capacity on hand—unless approval to operate domestic trunk routes comes quickly. A C.P.A.L. engineer's reaction to this suggestion was simply: "The DC-6B is the most adaptable transport yet built. We can put it on any route you like to name and make money. We'll find a use for it."

C.P.A.L.'s domestic arrangements for introducing the Britannia appear to have been straightforward enough. Ground equipment has presented no problems ("we just buy it"), and training seems to be progressing smoothly. The chief pilot, Capt. Harvey Johnson, and the Britannia fleet chief pilot, Capt. W. S. Roxborough, together with one other senior captain and the chief navigator have recently begun training at Filton under the terms of the contract (which may be extended to include three more captains). C.P.A.L. could not have started training earlier, because their cockpit layout differs considerably from previous production Britannias.

A normal C.P.A.L. flight crew will comprise three pilots, who will do all the communications and flight engineering, and—on the tiring long hauls—two navigators. Three crew-bunks are installed.

Selected base-engineers have done their ground training at Bristol, and are now passing on their knowledge to C.P.A.L.'s Britannia personnel in the airline's school at Vancouver. Ground courses last six weeks.

A Redifon Britannia flight simulator, to be delivered in the summer, will economize on airborne crew-conversion-time, though the present programme actually calls for about 15 hours of Vancouver-based training flights per crew, followed by a minimum of three route-proving flights. Twenty-five fully-trained Britannia crews is the target.

Long-range flights by the Britannia are becoming so routine now that I do not propose to describe the record flight home—Vancouver to London non-stop—in any detail. But worthy of mention is Bristol's handy new guide to Britannia-cruising. Packing several pounds *avoirdupois* of manual into a single paragraph, it exemplifies an obedient answer to the classic Churchillian demand ("Pray let me have, on one sheet of paper . . ."):—

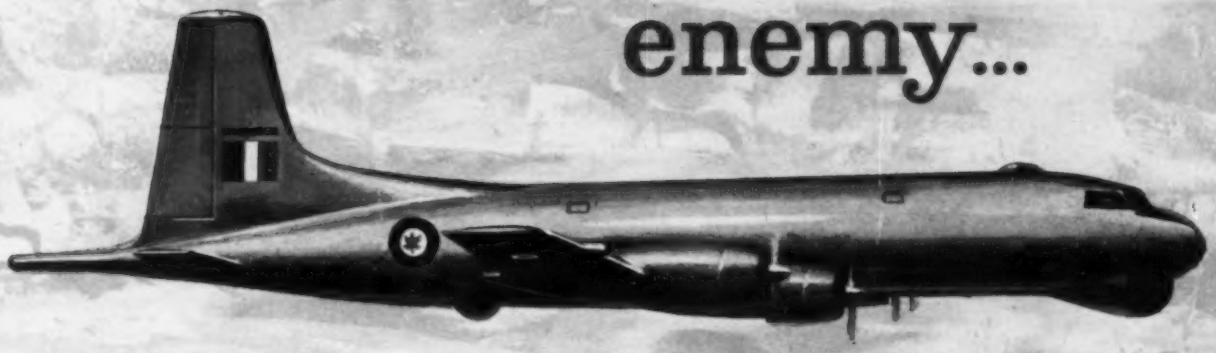
"(1) Climb to the highest quadrantal height the aircraft can comfortably reach. (2) Fly level. (3) Ascertain weight and wind, and from top chart read off target speed. (4) Allow the aeroplane to gather speed until target speed is reached. (5) Climb 2,000ft. (6) Repeat 3, etc. (7) When destination is in the bag, and if it is desired to make better speed at the expense of fuel consumption, ascertain (a) present fuel, (b) fuel required to complete the flight, with safety allowances, following the economy technique, then divide (a) by (b). When doing stage 3 read the target speed from the lower charts."

On the reverse side of this piece of paper (which is covered with acetate for durability) are three simple charts showing target speeds *versus* weight, with winds fed in, for (1) maximum range, (2) for when fuel available over fuel required equals 1.1, and (3) for when the same fraction equals 1.2. You must have a good grasp of the full technique before you can use this short-cut, but it seems to give results which compare closely with the elaborate method. For example, using it on the way out, we had consumed 44,000 lb of fuel after nine hours' flying. We reckoned from checks with figures on other long-range "elaborate" Britannia flights that this was within plus or minus 2.2 per cent, for nearly the same mean speed and distance covered.

As any commercial transport aircraft firm will tell you, there is no short-cut to short-cuts like this. That small piece of paper somehow symbolized the right sort of practical approach to the selling of a practical aeroplane.

On the left a fuel-management conference is seen in progress during the non-stop flight from Vancouver to London. Bristolian participants (l. to r.) are Messrs. Peter Masefield, Walter Gibb, and Keith Turner. Right, a picture which indicates by inference the awe-ing, unforgettable grandeur of the Rocky Mountains, as they were seen from the first homeward-bound stepped-climb cruising-level of 23,000ft. Note the sleeping-berth, five of which are installed for C.P.A.L.

To seek the hidden enemy...



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The Canadair CL-28 is the most formidable search, strike and kill maritime patrol weapon in the air today. It is in quantity production for the Royal Canadian Air Force and is available for purchase.

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It was specifically designed for long periods of ocean patrol duty . . . tactical coordination with naval surface craft on defensive and offensive manoeuvres...convoy and search-rescue operations.

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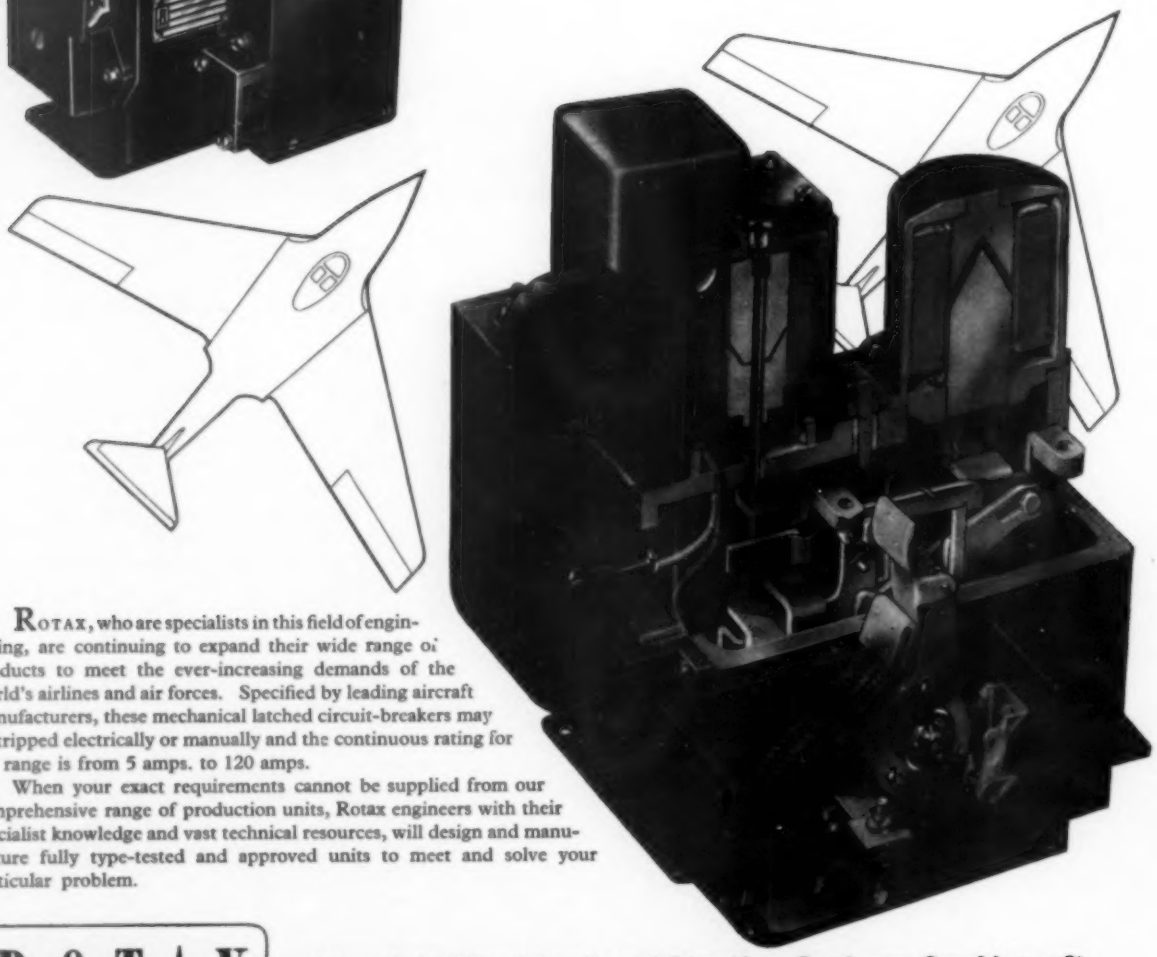

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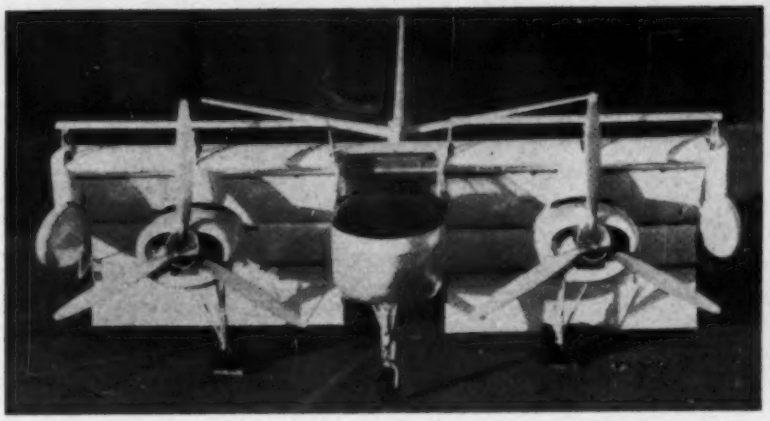


***VENETIAN-BLIND** flaps are a feature of this VTO executive aircraft being developed for the Aero Design and Engineering Co. by its subsidiary, Robertson Aircraft. It is hoped that VTO performance—by means of deflected slipstream—will be reconciled with a cruising speed of well over 300 m.p.h.*

HERE AND THERE

NATO Display

A NATO air display is to be held at Soesterberg, the Royal Netherlands Air Force base near Utrecht, on July 5.

Out of Range

AN agreement under which the R.A.F. was permitted to use the Grosse Knechtsand, a sand spit off the North German coast, for bombing is not being renewed after bird-lovers' and fishermen's protests.

Shifting the Snow

THE Swiss are using small air-to-ground rockets to precipitate avalanches in the alps. Fired from light aircraft, the rockets weigh nine pounds and penetrate hard-packed snow to a depth of over six feet, making a hole about nine feet in diameter.

Electronic Abbreviation

THE name of the Radio Communication and Electronic Engineering Association is to be changed on March 1 to "The Electronic Engineering Association." Mr. F. S. Mockford, of Marconi's Wireless Telegraph Co., Ltd., has been re-elected chairman for the coming year.

Maximum Identification

MORE conspicuous colours are to be carried by R.A.F. training aircraft, which since 1935 have worn distinctive yellow markings. Fluorescent orange paint will replace the yellow hitherto used for the bands round the rear fuselage and wings, and the wing and tailplane tips are to be finished in fluorescent orange.

Bristol in South Africa

KNOWN as the Bristol Aeroplane Co. (S.A.) Pty., Ltd., a new company has been formed in Johannesburg as a subsidiary of the Bristol Aeroplane Co., Ltd., to co-ordinate company sales, service and other activities. The chairman is Mr. C. F. Uwins

Mr. Noel Holman.

(deputy chairman of the parent company); and Mr. Noel Holman, who has been South African representative for the company since June 1956, and who began his career with Bristol as a student apprentice in 1935, has been appointed managing director resident in Johannesburg.

Guess What . . .

THREE thousand letters from Mr. Eric Turner, chairman of Blackburn and General Aircraft, were recently delivered by company apprentices to residents of three villages in the vicinity of Brough airfield. The letters contain a warning that there will be "a little more noise than usual" during the next few weeks due to the testing of turbojet engines, but that all measures will be taken to reduce possible inconvenience.

Long Haul

COVERING 8,000 miles in 100 hr flying, a Chinese pilot, Mr. Aw It Haw, recently completed a solo flight in an Auster from London to Singapore.

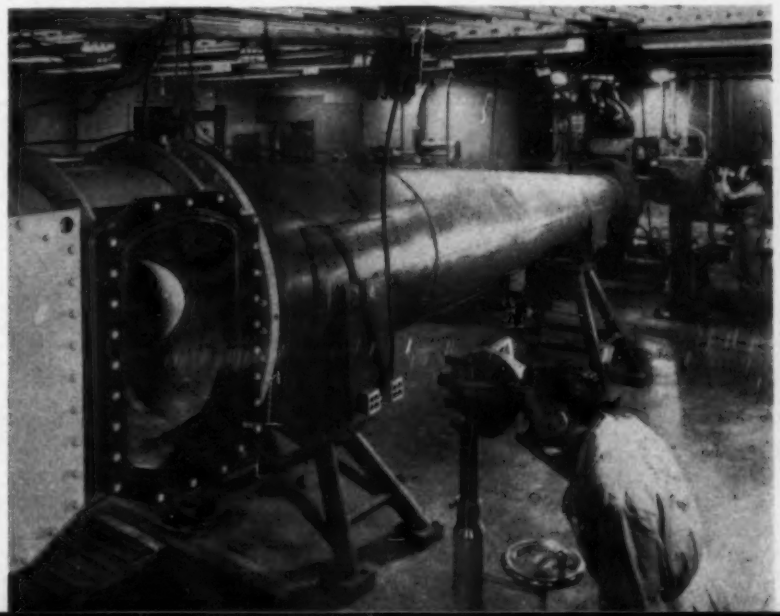
Formosan Base

WHEN Kung Quan airfield on Formosa is completed next year it will have a two-and-a-half-mile runway—one of the longest in the world. Construction is being undertaken by the U.S.—officially to provide a base for Gen. Chiang Kai-shek's Chinese Nationalist Air Force—at a cost of £9m, and the airfield is near the provincial capital of Taichung, in central Formosa, about 100 miles south of Taipeh.

Model Championships

THIS year's model aircraft world championships are being held over the August Bank Holiday weekend at the College of Aeronautics, Cranfield, Beds. The contest for powered models will be on Sunday, August 3, and that for rubber-driven types—for the Wakefield Trophy—on August 4. The championships are being organized by the Society of Model Aeronautical Engineers and teams from all over the world—including the Soviet Union—are expected to take part.

***THE FASTEST:** The heat-stained Lockheed X-7 ramjet research vehicle below was recently recovered after exceeding Mach 2.5, a high figure for an air-breathing aircraft. The new arc-driven tunnel Hotshot II (right) at the U.S.A.F. Tullahoma facility has actually exceeded the earth's escape velocity; peak Mach number is about 50 (32,400 m.p.h.) for 0.1 sec.*



THE OPERATIONAL OLYMPUS

Flight Development of Bristol's Big Turbojet

IT was on May 6, 1950, that the Engine Division of the Bristol Aeroplane Co. (now Bristol Aero-Engines, Ltd.) first ran the prototype Olympus engine. At that time this extremely efficient two-spool (split-compressor, or compound-compressor) turbojet had a design thrust of 9,140 lb. Today production engines are rated at 13,000 lb dry (104 series) and over 16,000 lb dry (200 series). In this article an outline is given of the recent development of the Olympus for operational service as the powerplant of the Avro Vulcan bomber. At the end is appended a bibliography of related articles published by this journal.

Initial development of the Olympus under the conditions it would experience in the air was carried out at A. V. Roe's facility at Woodford, Cheshire, in a special rig consisting of one half of a Vulcan wing mounted in the correct attitude and at the same height from the ground as would be the case if the wing formed part of the complete aircraft. This rig enabled a great deal of test work to be done much more easily than it could be in actual flight and it saved several hundred hours of test flying. The first Olympus to run in the wing rig was a Mk 100 in February, 1953. Among the items studied were the intake airflow conditions. It was found that the design of the intake was exceedingly good, having very high efficiency and not giving rise to any handling difficulties. In view of the well-known problems caused by the effect of intake airflow on axial-flow compressors, the fact that slam accelerations could readily be performed showed that the engine and intake were well matched.

Development work was also carried out on the wing rig to improve engine-bay cooling, chiefly through the development of an efficient design of extractor in which the propulsive jet entrained an airflow in the surrounding annulus to provide an adequate flow through the engine bay. This extractor had to be designed not only for ground level but also to ensure that the airflow did not reach sonic velocity under altitude conditions. In addition, the type of joint hitherto used between the jet pipe and the engine—using piston-ring seals—was found to allow considerable leakage of exhaust gas, and a form of bellows joint was developed to overcome this problem. The wing rig was also used to assist the development of the cabin pressurization system, the pressure air being tapped from the high-pressure compressor delivery of the Olympus engine. In all the wing rig has logged about 600 hours' running.

The first Olympus-powered Vulcan to fly was the second prototype, VX 777, which took the air on September 3, 1953, with four Olympus Mk 100 engines. This aircraft was flown at the 1953 S.B.A.C. display before being handed over to the A. and A.E.E. at Boscombe Down for trials. It was found desirable on this aircraft to modify the area of the turbine stators in order to improve the general engine handling, and the same conclusion was reached as a result of trials of the Mk 100 engines in the Canberra test bed used by Bristol for engine flight-development. Wherever possible it was arranged that the engines were removed for modification concurrently with work necessary on the airframe, in order to avoid holding up the flight development programme. At this time a selective fuel-feed system was being developed for the Vulcan. This was arranged to draw fuel from a series of tanks consecutively for pre-determined periods, in order to maintain the aircraft c.g. within the desired range. Work was also carried out on the aircraft pressurization system.

Unfortunately VX 777 suffered a forced landing at the R.A.E. Farnborough in July 1954 (through reasons unconnected with the powerplants) and this incident terminated the series of tests on the Olympus 100. Towards the end of 1954 the first Olympus Mk 101 engines were installed, each delivering a take-off rating of 10,000 lb (compared with 11,000 lb delivered by production engines of this mark). The engines installed at this time did not incorporate the turbine-stator modification found necessary on the Mk 100, though this was subsequently found to be equally desirable on the later engines.

Meanwhile the first production Vulcan, XA 889, became the first to fly with Olympus 101 engines, achieving its first flight on February 4, 1955, a few days before the second prototype became airborne with this mark of engine. VX 777 was returned to Boscombe Down and did a considerable amount of flying, including initial handling trials, in the first half of that year.

On the whole the engine performed very satisfactorily during these trials, very few mechanical difficulties being experienced. The main problems encountered were the "creep" of engine speed with altitude (which is present to a greater or lesser extent in all turbojet engines) and the fact that, at their maximum continuous speed, the engines run close to—and can, on occasions, exceed—the maximum permissible jet-pipe temperatures. Somewhat greater r.p.m. creep was found than had been expected, and this was partly accounted for by the length of the push-pull throttle linkage between the cockpit and the engines. The effects of cabin pressurization and the decrease of temperature with altitude were found to cause slight extension of the linkage with respect to the airframe, thus causing fractional opening of the engine throttles.

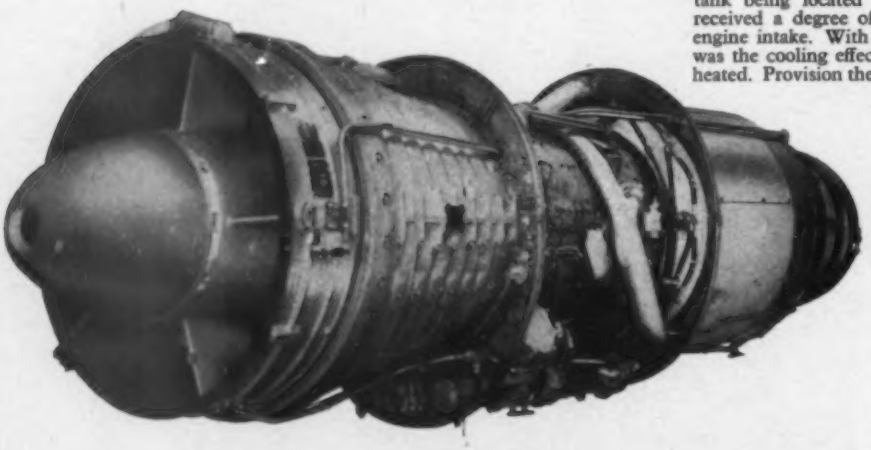
As a result, it was decided to introduce an engine-speed governor set at the cruising r.p.m. (in addition to the normal top-speed governor). The double-datum governor incorporated a solenoid-operated isolating valve to enable maximum r.p.m. to be obtained at take-off, the cruising governor being brought into circuit by the operation of a switch after the aircraft became airborne. It was found that, using this system, the maximum engine performance could be obtained while keeping the j.p.t. within permissible limits.

As a result of the initial handling trials carried out at Boscombe Down a considerable amount of effort was devoted to the question of obtaining the optimum handling characteristics. Development flying was carried out using different settings of the engine idling speed and of the fuel control in order to achieve the optimum results. One interesting fact which emerged from this work was that the worst engine handling was invariably experienced on the port inner engine. It was found impossible to establish the exact reason for this, though it was thought that the run of the control linkage and the nature of the airflow conditions in the intake were partly responsible.

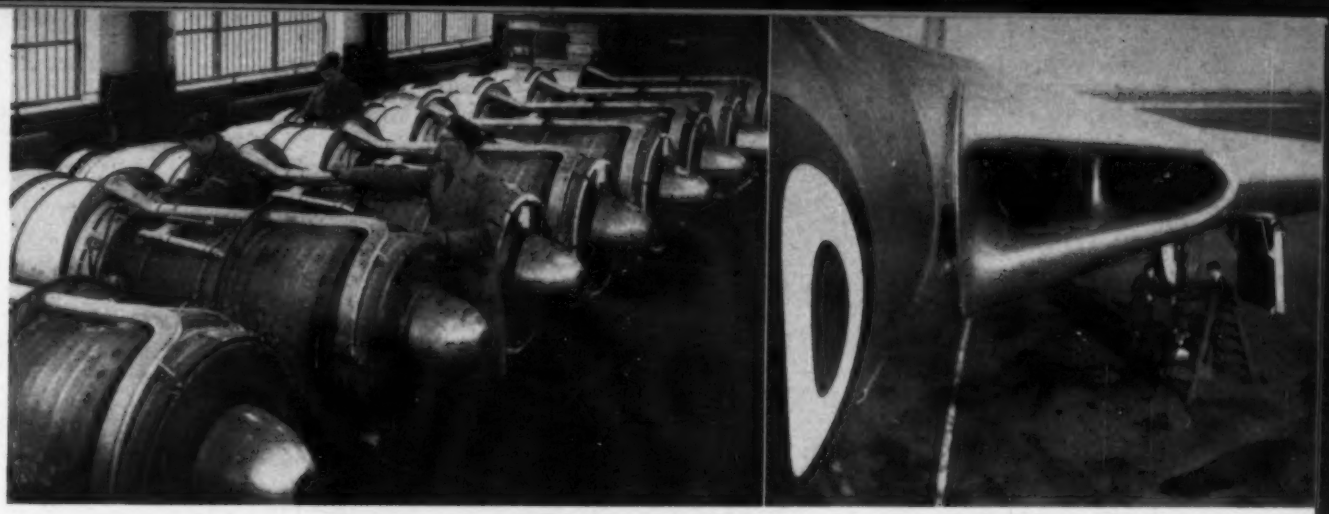
As a result of the development work, a value of the idling speed was established which, while being sufficiently high to provide for the needs of the electrical generators with all engines throttled back, did not result in excessive residual thrust. The idling r.p.m. increases with altitude, to more than double its sea-level figure at the highest altitudes. This is inherent in turbojet design but has the advantage that it counteracts the increased tendency of the engine combustion to be extinguished as height is gained (this, however, has never been a problem on the Olympus).

Another aspect of development concerns the anti-icing system. This is effected by hot air, tapped from the compressor delivery and fed to the air-intake casing where it is also circulated through the nose bullet. One of the subsidiary problems which arose during the development of this system was that, as a result of the oil tank being located in the air-intake casing, the oil normally received a degree of cooling from the airflow passing into the engine intake. With the anti-icing system in operation, not only was the cooling effect lost but the oil was in fact to some extent heated. Provision therefore had to be made to ensure that adequate oil cooling was always available.

A further problem was that the total-head probe, which senses the dynamic air pressure required for fuel-system operation, tended to become iced-up in its original location on one of the vanes of the intake casing. The probe was therefore moved to a position within the nose bullet, which has a relatively large aperture at its tip to take in ram cooling air for the genera-



The present production mark for the Vulcan B.1 is the Olympus 104. The dry rating is 13,000 lb; other particulars are given on p. 303.



Taken at R.A.F. Waddington, these photographs show engines due for routine overhaul (left) and the port intake of a Vulcan (right).

tor located inside. The bullet was itself heated by circulation of hot air, and because of its large diameter this arrangement has been referred to as "the biggest heated pitot in the world." As a result of this work, the Olympus 100 series engines were fully cleared for operation in severe icing conditions and thus represent the highest standard of anti-icing protection.

Meanwhile, engines delivering the full 11,000 lb (dry) thrust of the Mk 101 were installed, and flew for the first time in July 1955. These were among the most powerful production engines flying anywhere at that time. Later the same year the second and third production aircraft took the air, the first six machines being used initially for development purposes, particularly including the armament, radar and other equipment. Apart from XA 889 already mentioned, the only machine used for development connected with the engines was the fifth production aircraft, XA 893, which was assigned the task of proving the A.C. electrical system which is being introduced on later aircraft. An essential part of this system is the Sundstrand drive, licence-produced by English Electric at Bradford, which enables the alternator to be driven at the required constant speed over a wide range of engine r.p.m.

Events have shown that this policy of intensive development on early aircraft, which was carried out by the manufacturers, A. V. Roe and Co., Ltd., the government establishments, and Bristol Aero-Engines in full co-operation, was very sound. It has paid handsome dividends by ensuring that even minor troubles were overcome before delivery of the aircraft to the Royal Air Force. As a result the Vulcan, in the words of the Under-Secretary for Air, "has probably had the minimum amount of teething trouble of any aircraft introduced in the R.A.F. over the last ten years."

Bristol Olympus. All Olympus engines are split-compressor turbojets, each compressor spool being driven by a single-stage turbine. The basic Olympus 101 has a six-stage l-p. spool and an eight-stage h-p. spool; later 100-series engines have a zero-stage on the l-p. spool. Ten flame-tubes are fitted in the annular combustion chamber. Overall diameter is approximately 40in and length about 150in. Mean figures for production 101 and (in brackets) 102 engines are: weight, 3,615 lb (3,793); thrust, 11,034 lb (12,009); specific consumption, 0.817 (0.811).

During 1956 the Vulcan was in the hands of Boscombe Down for a full assessment of handling and performance, and this resulted in full clearance being given to the aircraft and the Olympus 101 engines for Royal Air Force service. After completing the normal contractor's trials, the first aircraft for the Royal Air Force was handed over during the summer of 1956. The large amount of flying which was achieved, starting immediately after the aircraft was received by the service, is an eloquent testimony, not only to the trouble-free nature of the aircraft, but also to the enthusiasm of the operating aircrew and ground crews (this first aircraft carried out over 200 hours' flying in its first four months of service).

During the summer of 1956 the R.A.F. received a number of Vulcan B.1 aircraft powered with the 11,000 lb-thrust Mk 101 engine. Most of this first batch of Vulcans were assigned to No. 230 Operational Conversion Unit at Waddington, and have since been engaged upon the training of Vulcan crews. In October 1956, however, one aircraft (XA 897) was picked to fly on an extensive tour of Australia and New Zealand.

This tour was marred by the tragic accident at London Airport at its conclusion (*Flight*, February 1, 1957), but was otherwise extremely successful. It had been carried out to a pre-arranged schedule, the aircraft visiting Melbourne, Sydney and Adelaide on the outward journey and Brisbane and Darwin on the return, in addition to the airfields at Christchurch and Ohakea in New Zealand. A point-to-point record was established between Adelaide and Christchurch, the section between Hobart (Tasmania) and Christchurch being covered at an average speed of 634 m.p.h. En route to Australia the aircraft flew non-stop from Aden to Singapore and from Singapore to Melbourne, taking off heavily loaded under tropical conditions.

During the tour, which covered approximately 30,000 miles, the engines behaved literally perfectly, and the only attention which was given to them was two routine inspections involving little more than visual examination and cleaning of filters.

As a result of the inspections of engines used in the two prototype Vulcans, the initial overhaul period for the Olympus 101 was fixed at 200 hours. It was agreed that an intermediate flame-tube inspection was not necessary.

Meanwhile, further aircraft were delivered to the Royal Air Force during the early part of 1957, and the amount of flying carried out increased correspondingly. A feature which was introduced at an early stage was a cruising-speed governor, to maintain the engine rotational speed at a constant value during climbs and under altitude cruising conditions. It is well known that, when a turbojet is operating at less than maximum governed r.p.m., a slight variation in engine speed tends to occur with change of altitude, and the introduction of the cruising-speed governor relieves the pilot of the necessity for watching the engine speed and adjusting the throttles under these conditions.

With early Olympus 101 engines there were cases of failure of the starter quill-shaft as a result of the shock loading when the drive was taken up during starting. Although it had no particularly serious consequences, this was an embarrassing type of failure because it occurred when the aircraft was otherwise ready to taxi out and take off on a mission. Accordingly, a revised drive was introduced, and this cured the trouble.

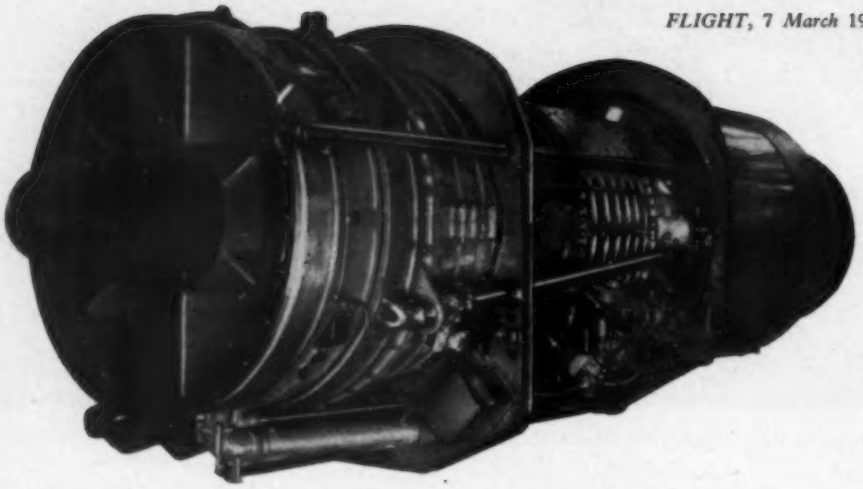
Only a relatively small number of aircraft were delivered with the 11,000 lb Olympus engine before the Olympus 102 (described below) was introduced, with a dry rating of 12,000 lb. However, before an adequate number of aircraft powered by the Olympus 102 had been introduced into service, No. 83 Squadron entered the annual bombing competition of Bomber Command using the Olympus 101-powered aircraft. This was the first official announcement of the formation of No. 83 Squadron, the first operational unit to receive the Avro Vulcan. Based at Waddington, No. 83 Squadron was formed from crews which had completed their training with No. 230 O.C.U. at the same station.

In July the results of the competition—which was flown from R.A.F. Marham at the end of June—were announced. Although recently formed, and competing with numerous other squadrons using well-established aircraft, the Vulcan squadron succeeded in winning the Laurence Minot Trophy, awarded to the medium bomber squadron gaining the highest total of marks in bombing and navigation. The squadron also won the Sir Philip Sassoon Trophy for the best navigational results throughout the competition. The Commanding Officer of No. 83 Squadron, Wing Commander A. D. Frank, D.S.O., D.F.C., won the individual awards both for navigation and for bombing and navigation together.

Competing aircraft made cross-country flights of five hours' duration, at the end of which simulated radar-bombing attacks were made from altitudes of between 40,000 and 50,000ft on pre-selected targets. Throughout the competition not one Vulcan failed to complete a scheduled flight, which is an indication of the exceptional reliability of both the airframe and engines at this early stage of their career.

Turning now to the Olympus Mk 102, it should be noted that this engine is similar to the 101 but has an additional zero-stage on the low-pressure compressor. This has the effect of increasing the mass-flow and pressure ratio, and consequently the thrust. However, it also results in alteration of the engine handling characteristics, and on early flight tests it was found that the handling of the 102 engine at altitudes above 45,000ft was not all that could be desired. The engine's behaviour was perfectly satisfactory over

THE OPERATIONAL OLYMPUS . . .



This is the first picture to be published of a production Olympus 200 for the Vulcan B.2. Rated at 16,000 lb (with more in prospect) the unit includes an English Electric (Sundstrand) variable-speed drive, mounted on the starboard side.

the normal cruising range, but in the lower speed range it was not up to specification. As mentioned earlier, one solution would have been to reduce the area of the turbine stators; however, as the Olympus is a two-spool (split-compressor) engine, the beneficial effect obtained on the low-pressure compressor would have resulted in the high-pressure spool having to run at a higher rotational speed. This design-change would have taken some time to develop to the necessary degree of reliability. It was therefore decided to reduce the area of the exhaust nozzle, thus increasing the back-pressure on the turbine and reducing the work done by the low-pressure spool. At the expense of a small reduction in thrust (which was of small importance, in view of the engine's rating of 12,000 lb, as compared with the 11,000 lb Olympus in the aircraft already flying) this was found to result in very satisfactory handling characteristics, the acceleration times at high altitudes being even better than those of the Mk 101. Moreover, the thrust at altitude was substantially unaffected by the alteration in the final nozzle size, and on flight tests it was found that slam accelerations could actually be done from less than standard idling r.p.m. at any altitude which the Vulcan could reach.

In fact, the Olympus is believed to be the only engine at present in service anywhere in the world upon which slam accelerations and decelerations can be conducted at the highest altitudes reached by subsonic aircraft. An official report, written by an authority familiar with gas turbines on both sides of the Atlantic, includes the passage "the Olympus 102 sets a standard of handling at altitude which has never been equalled by any other turbine engine . . ."

First aircraft to be powered by the new mark of Olympus was Bristol's Canberra B.2 test-bed WD 952, which established altitude records of 63,668 and 65,890ft with first-generation Olympus engines. Vulcan XA 889, the first production machine already referred to, was fitted with four Mk 102 engines after its clearance from Boscombe Down, and it flew with these powerplants in March last year. Four more were installed in the second prototype VX 777 last summer, while this aircraft was in the shops at Woodford being fitted with a wing similar to that of the future Vulcan B. Mk 2.

By this time the R.A.F. was steadily receiving Vulcans with Mk 102 engines, supplementing the first batch in service with the Olympus 101. The latter powerplants were being run at this time to an overhaul period of 250 hours, and, as a result of their very satisfactory condition when stripped, the overhaul life was increased in September to 300 hours.

The U.S.A.F. Strategic Air Command's bombing competition was held at Pinecastle A.F.B., Florida, in October. On September 26 three Vulcans left Waddington, flying non-stop to Goose Bay, Labrador, and thence to Florida, in order to compete. The story of this competition is now old history. It is, however, worth mentioning that the aircraft flown by the A.O.C-in-C. Bomber Command, Air Chief Marshal Sir Harry Broadhurst, suffered not a single engine fault during the whole time that the aircraft was away from the United Kingdom. During this period only three minor faults were reported on the other aircraft, including such things as a fractured pipe and a fuel-control unit which permitted a slight r.p.m. variation. The excellent serviceability of the Vulcans was favourably commented on at Pinecastle, as was their very low oil consumption. The aircraft flown by Sir Harry Broadhurst returned from Washington D.C. to Marham, Norfolk, in 6 hr 12 min, an overall point-to-point speed of 582 m.p.h. for a distance of 3,645 statute miles.

In the meantime, the Olympus 102-powered aircraft carried out a considerable amount of flying at Waddington, and the overhaul life was set at 200 hr (since raised to 250) after some 102s had been inspected by Bristol at 100 or 150 hr. The first involuntary removal of an Olympus 102 occurred in November when a quill-shaft in the generator drive was found to have failed.

Overall, the Olympus has demonstrated astonishing reliability. The first mark to acquire operational time, the 101, established a time of approximately 1,700 hr per unscheduled removal up to the end of last year, and the rate is now further improved. The more powerful Mk 102 has so far established a corresponding time of more than 3,000 hr. These times are strictly comparable with corresponding times for highly developed commercial piston engines after years of airline service.

Without for a moment suggesting that an engine can be made "too reliable" it is correct to state that an engine designer always strives to strike the optimum compromise between reliability and power. The record of the Olympus indicated at an early stage that the engine could be up-rated to give still greater thrust, without sacrificing the engine's remarkable reliability. Late in 1956 it was decided to incorporate certain minor internal changes to permit the engine to run at higher gas temperatures and thus give 1,000 lb additional thrust. The revised engine, the Mk 104, completed its type test at 13,000 lb dry in December 1956 and flew in Vulcan XA 889 last July. The Mk 102 can be brought up to 104 standard during overhauls.

This engine incorporates not only the double-datum speed governor but also a double-datum jet-pipe temperature limiting device. The latter also has a cruising and take-off setting, and both the speed governor and the temperature limiting device are controlled by a single pilot-operated switch. With this arrangement the pilot takes off at full throttle and, when airborne, throttles back to slightly below the cruising r.p.m., and operates the engine switches. The throttles may then be opened up to their maximum extent without any risk of the maximum cruising r.p.m. or jet-pipe temperature being exceeded. The engines may then be ignored until the pilot needs to reduce power at the end of the flight.

Flight trials with the Olympus 104 have been mainly concerned with investigating the engine handling characteristics, and these have been found to be completely satisfactory at all altitudes. The handling programme is still being continued, to ensure that satisfactory characteristics are obtained not only on one aircraft under standard atmospheric conditions but also in all combinations of aircraft under non-standard atmospheric conditions. It is expected that the handling will be at least up to the standard set by the Olympus 102 before production aircraft with the 13,000 lb-thrust engines are received by the Royal Air Force.

The Vulcan B. Mk 1 with Olympus 100-series engines is now being succeeded on the production line by the Mk 2 aircraft with the 16,000 lb thrust (initial rating) Olympus Mk 200. Accordingly, the next stage of flight development will be concentrated on this completely redesigned engine, and a development aircraft fitted with four engines of this rating is due to fly within the next two or three months. The additional thrust from the second-generation Olympus, which is one of the most powerful engines in production in the world, will considerably enhance the performance of the Vulcan and will enable full advantage to be taken of the improved wing design of the Mk 2 aircraft.

Bibliography. The following issues of *Flight* contained articles on subjects related to the above:—

July 2, 1952: first description of the Olympus engine. February 4 and 11, 1955: announcement and details of first production engines.

December 9, 1955: full description, with cutaway drawing, of basic 100-series Olympus, together with history of design and development.

February 15, 1957: history and description of second-generation Olympus BOl.6 (200-series).

January 31, 1958: history and description of the Avro Vulcan.

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AE 30

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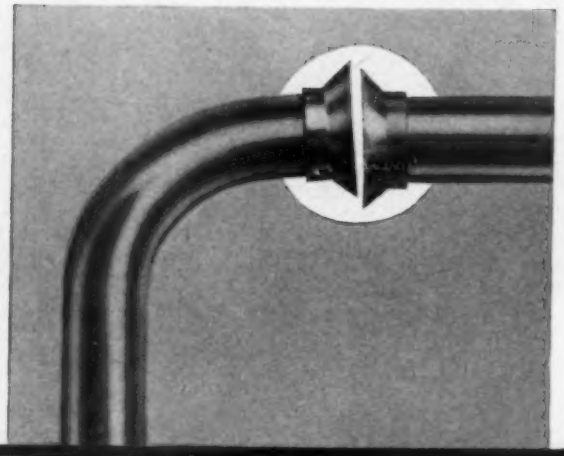
A question of tolerances?



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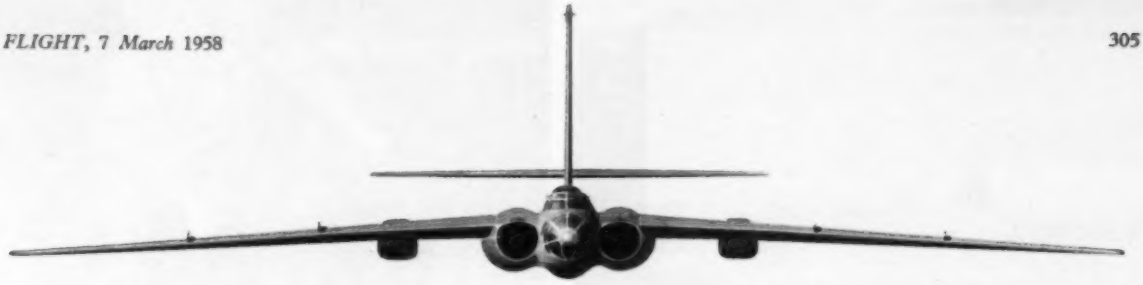

"BADGER"
(Tu-16?) Provisional Drawing

Span (approx.) 112ft
Length (approx.) 118ft

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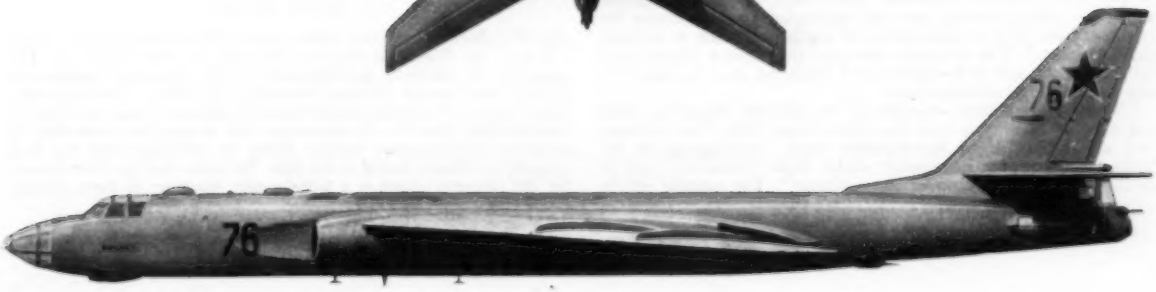

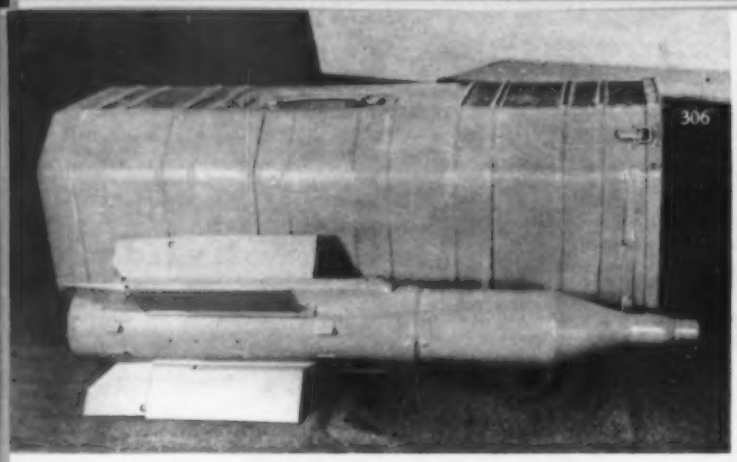

Above, a V.891, with contact probe extended, is pictured with its glass-fibre canister/launcher. Above, right, a canister spike is being driven, and the third photograph shows two weapons ready for a target.

VICKERS 891

A Guided Weapon for the Foot-soldier

FIRST revealed at the 1957 S.B.A.C. Exhibition, and described in our issues of September 6 and 13 and December 6 last, the Vickers-Armstrongs Type 891 is not (as might at first be thought) a new mark of Viscount, but an infantry anti-tank weapon with numerous outstanding qualities. Like the pioneering German and French weapons of a similar nature, it is a cruciform-winged projectile powered by an internal solid-propellent rocket motor and provided with control surfaces moved according to signals transmitted through a fine wire linking the weapon with its launcher.

The projectile itself has a conical nose, fitted with a retractable contact probe, and a main body section and motor pressure-vessel made in aluminium alloy. The wings are plastic shells reinforced with glass-cloth and filled with foam plastic. Between the wings are two detachable fairings which house the printed-circuit electronic components of the guidance system and provide a means of linking the equipment at both ends of the rocket motor pressure-vessel. The motor has been developed to give good performance throughout its burning period, and its igniter need not be screwed into position until the missile is ready for action.

For use, the weapon is packed in a combined canister/launcher which provides protection against shocks and adverse environmental conditions. The missile is mounted by two pairs of lugs engaging with a launching rail inside the box roof. When a target is sighted, the operator opens the box and folds the lid down to act as a prop to maintain the box at the required launching angle of some 20 deg; two spikes can be inserted through the front of the box and lid, and driven into the ground to prevent the box from moving when the weapon is launched. A rubber blanking cap is removed from a hole at the rear of the box to provide an orifice for the motor exhaust.

Guidance is by means of a simple optical line-of-sight command system. The operator employs a thumb-stick like a miniature control column, the position of which is signalled through a cable to the launcher and thence to the missile itself via insulated wire unwound from a spool encircling the motor nozzle. The operator sights on the target (using optical magnification at long ranges) and, assisted by a flare carried by the weapon, he endeavours to keep the missile on the line-of-sight between himself and the target. Vickers state that the velocity closed-loop system is simple and accurate, and allows a wide angular coverage.

As noted in our December 6 issue, the missile has a body diameter of 4.5in, a wing span of 11in and a length of 33in (when in its container the length is somewhat less, since the contact fuse probe is then retracted). Various types of warhead can be fitted, the most common being a hollow-charge head of new design and great effectiveness. The complete missile and canister together weigh roughly 40 lb.

RECORD JANUARY

JANUARY export sales by the British aircraft industry amounted to £11,089,584. This is the largest January total ever achieved —the previous best being £8,343,236 last year—and the fourth highest monthly total ever recorded.

Aircraft and parts accounted for £6,726,855 (compared with last year's monthly average of £5.8m); aero-engines for £3,942,854 (compared with £3.4m); electrical components for £246,041; instruments for £127,495 and tyres for £46,339.

India was the industry's best customer, spending £1,568,242; Iraq the second with £1,137,363.

GUILD AWARDS

AWARDS for 1957 of the Cumberbatch Trophy and the Derry and Richards Memorial Medal have been announced by the Guild of Air Pilots and Air Navigators. The Trophy (donated by Miss Alice Cumberbatch in 1931 "for the promotion of reliability in civil aviation") goes to Malayan Airways, Ltd., who in the words of the Guild's citation "have made a positive contribution to air safety, having operated scheduled public services for over ten years with a high degree of regularity, often in difficult circumstances." The company operates throughout Malaya and British Borneo and to Indonesia and Thailand, and its record to date is completely accident-free.

The Medal has been awarded to Mr. Michael Randrup, chief test pilot of D. Napier and Son, Ltd., since 1946, "for his long and meritorious flight development work, culminating in the testing of an engine installation under flight conditions well in excess of the design limit of the airframe." The citation recalls that it was in the course of this development flying that a Scorpion Canberra B.2 piloted by Mr. Randrup last year gained the world altitude record of 70,310ft. Both awards are to be presented at a G.A.P.A.N. banquet in London on May 28.

J83-POWERED JETSTAR—

LOCKHEED AIRCRAFT'S California Division have placed an order with Fairchild's Engine Division for an undisclosed number of J83 turbojets. The original CL-329 Jetstar design was planned for four G.E. J85 or Fairchild J83 engines, but the first two aircraft are powered by twin Bristol Orpheus. The latter engines are being imported by Curtiss-Wright as the TJ-37 and are being offered by Lockheed as an alternative powerplant.

Fairchild's J83 weighs about 400 lb dry and has a thrust of some 2,000 lb with a possible extension to 2,500 in several years' time. Lockheed are scheduled to get the first J83s in about one year's time. Except for Fairchild's own SM-73 Bull Goose weapon, this is the first firm order for the new Fairchild engine.

—AND CL-41

AGREEMENT has now been reached between Canadair, Ltd., and the Fairchild Engine Division for the supply of J83 turbojets as standard powerplants for the Canadian company's CL-41 basic trainer (*Flight*, December 13, 1957). Canadair state that, since their announcement last November of their decision to manufacture two CL-41 prototypes, the design has continued to progress satisfactorily, tooling being on schedule and the first assemblies already being in the jigs. No order has yet been placed for the aircraft, which is a side-by-side machine of clean design.

FIREFLASH

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"Flight" photograph

Sir George addressing his audience.

Speed: Its Influence on Transport

SIR GEORGE EDWARDS GIVES ROYAL AERONAUTICAL SOCIETY'S PRESIDENTIAL ADDRESS

CHURCH HOUSE, Westminster, was the scene of this year's presidential address to the Royal Aeronautical Society, given by Sir George Edwards, C.B.E., B.Sc., F.R.Ae.S., on Wednesday, February 26. Introducing Sir George, the chairman, Lord Hives, said that no one man had done more for civil aviation in this country. And, incidentally, he continued, all Viscounts had been sold to willing customers by a willing seller—it had never been necessary to consult the Cabinet on the suitability of the aircraft for the customer.

Sir George began his address by expressing his appreciation of the honour paid to him by Lord Hives—"the greatest British engineer"—in agreeing to take the chair. Films shown after last year's presidential address by Mr. E. T. Jones had given Sir George the idea of devoting all his time to such a medium, "thereby providing an evening of satisfactory entertainment for the ladies. . . ." Discussions with Mr. Ernest Bass, chief engineer of Shell Aviation Division, had, however, led him to compromise by devoting the latter part of his period to the Shell film *Transonic Flight*. Sir George had originally considered delivering a message to convince the people "that aviation has been, and still is, of great benefit to mankind"; but the need to have time to say something of the Society made it necessary for him to limit his theme to *The Influence of Speed on Transport*.

A major event in the Society's year, he said, had been the formation of a Guided Flight Section, a development that "has infused into the old body some vigorous and worthwhile new blood which looks like making it hop or jump about in a most undignified, and not very guided, fashion." Also during 1957 the Society acted host at the sixth Anglo-American Conference. This meeting had not only provided the means of bringing together a great many people with similar interests from both sides of the Atlantic, but had presented an opportunity to remind others that "the only turbine-engined transports which have flown a single hour in scheduled airline service have been British or Russian."

The last year had seen the organization of another (the second) highly successful R.Ae.S. Air Transport Course at Oxford, and also further progress in establishing a permanent home for the Society. The new development scheme for Hyde Park Corner might make possible the building of a lecture hall ("the thing which we would all most like") at the Society's premises at 4 Hamilton Place.

Another important feature of the last twelve months had been the further rapid growth in membership of the Society to over 10,000. The greatest credit for this must go to Mr. N. E. Rowe who, when president, started a vigorous campaign for recruiting new members, a policy energetically continued by Mr. Jones. A further 6,000 local branch members meant that "the Royal Aeronautical Society . . . now reaches no fewer than 16,000 people."

Coming to the second part of his address, Sir George indicated that he would endeavour to show the way in which speed in transport had developed, and how the demand for more and faster transport had been stimulated by the world's communities becoming industrialized.

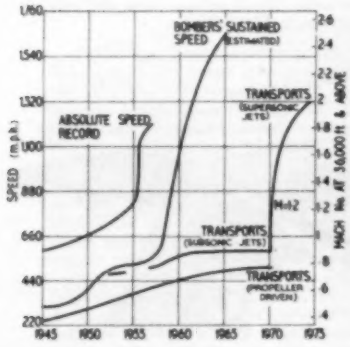
The president then showed a series of attractive slides to illustrate the improvements that speed has brought to travel since the 17th century (when a 12-hour day saw the pedestrian limited to a journey of about 20 miles, the horse-rider to some 30 miles, while those who "were rich, or alternatively ran an expense account" could travel 75 miles by stagecoach in the 12-hour day "at the low price of about one shilling for every five miles"). The stimulus of the Industrial Revolution during the 19th century produced an increase in the day's journey-distance from 75 miles to over 500, this increase (a consequence of the railway train) being related to a sharp growth in population. This in turn probably sprang from a reduction in the mortality rate—"or could even be further evidence of the value of the bicycle to a young man in the spring."

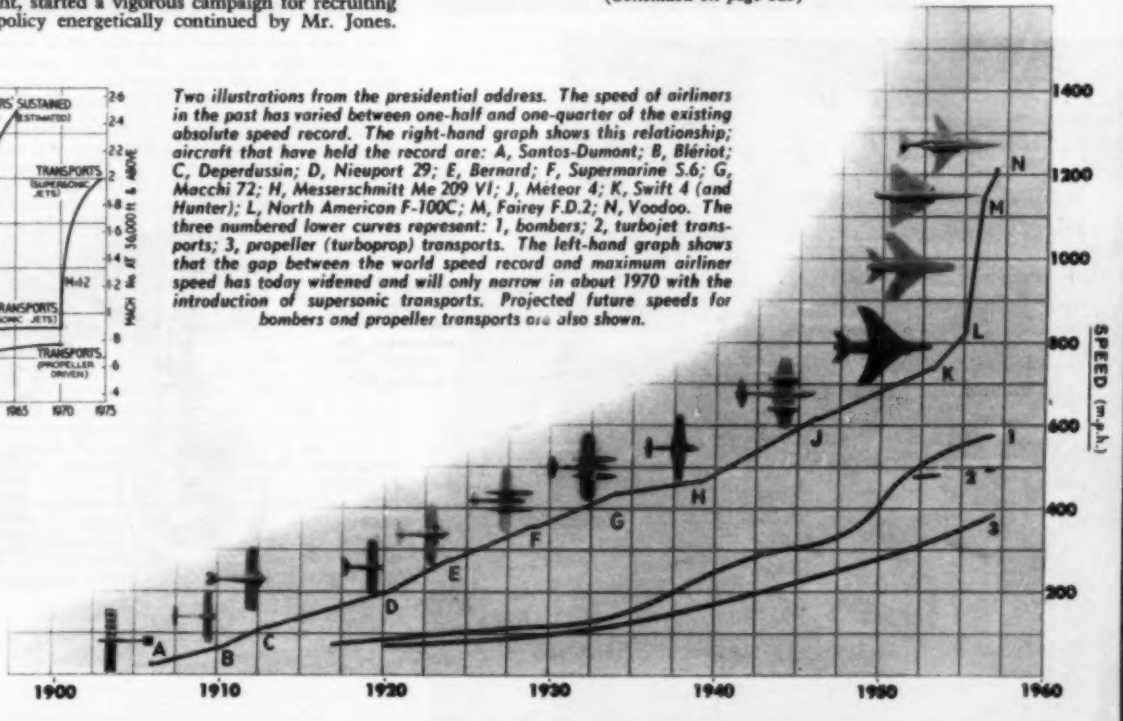
Sir George showed how the aeroplane had further pushed away the barrier set by a 12-hour journey to 1,250 miles in 1940 and to over 5,000 miles by 1960. He then discussed the effects of this extension on two particularly interesting routes, one across the Irish Channel, the other between North America and Europe. The reduction in journey-time brought about by the aeroplane (nine-tenths of journey-time across the Atlantic, two-thirds across the Irish Channel) has been associated with phenomenal increases in the total volume of traffic, increases in which surface transport has shared—"it could be that the upsurge of air travel has had a stimulating effect."

Sir George, reminding his audience that there was little purpose in talking about speed unless one related it to cost, showed that surface travel was still generally cheaper than flying. Nevertheless, analysis of the London - Dublin route had shown that the increases in traffic have come not from the higher income groups but from the less affluent. This, he thought, was a pretty positive demonstration that speed would encourage travel even though it would cost more. As regards "expense-account travellers," the evidence suggested that the volume of such traffic fell off sharply with increasing distance. Whereas business travel accounted for about one-half of air traffic inside "the 12-hour circle," the proportion fell to one-third on journeys of 24 hours, and to only one-sixth for more distant points.

Another slide showed the development of fare rates for various forms of transport, prices being adjusted to current values. This revealed that air fares are on about the same level as the 17th-century stagecoach (sevenpence per passenger-mile). The

(*Concluded on page 323*)





Two illustrations from the presidential address. The speed of airliners in the past has varied between one-half and one-quarter of the existing absolute speed record. The right-hand graph shows this relationship; aircraft that have held the record are: A, Santos-Dumont; B, Blériot; C, Deperdussin; D, Nieuport 29; E, Bernard; F, Supermarine S.6; G, Macchi 72; H, Messerschmitt Me 209 VI; J, Meteor 4; K, Swift 4 (and Hunter); L, North American F-100C; M, Fairey F.D.2; N, Voodoo. The three numbered lower curves represent: 1, bombers; 2, turbojet transports; 3, propeller (turboprop) transports. The left-hand graph shows that the gap between the world speed record and maximum airliner speed has today widened and will only narrow in 1970 with the introduction of supersonic transports. Projected future speeds for bombers and propeller transports are also shown.

Ed Heinemann's

"Bantam Bomber"

A4D SKYHAWK

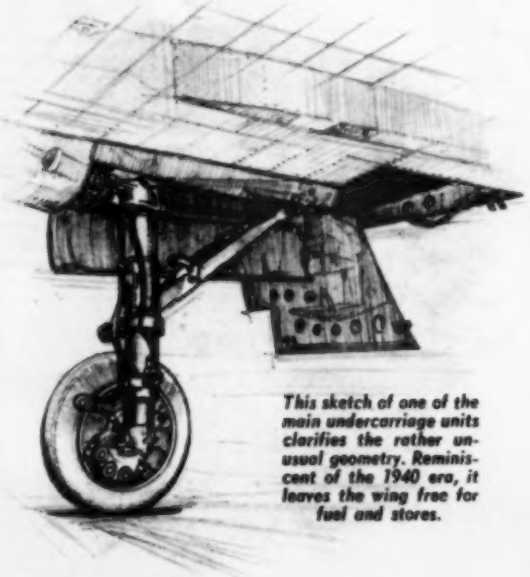
THE Douglas A4D Skyhawk is not a particularly advanced design of aeroplane; yet it is well worth a fairly close look, in view of the fact that it was specifically intended to do a difficult job easily and cheaply, and thus offers an ideal example of a design exercise running contrary to the general trend towards greater complexity and cost. On pp. 310-1 is a drawing which, besides giving a good indication of the principal features of the aircraft, emphasizes the ingenuity which has been applied at all points of the structure and equipment to produce a weapon system of minimum size.

For many years, the Douglas Aircraft Company's naval aeroplanes have been designed and built at the company's El Segundo plant adjoining Los Angeles International Airport. Chief engineer at El Segundo is Mr. Edward H. Heinemann, and almost a decade ago he was exploring the possibilities of producing a turbine-driven aeroplane to succeed the evergreen AD Skyraider. The first attempt was the A2D Skyshark, flown in the summer of 1950. This was little more than an AD airframe redesigned for higher indicated airspeeds and powered by a 5,500 h.p. Allison double turboprop. It was conspicuously unsuccessful (largely on account of the bad behaviour of the propulsive system). During 1951 and 1952, Mr. Heinemann's team continued their studies along entirely different lines, using a turbojet for propulsion and employing successive refinements in design to minimize the size of the aircraft. (Meanwhile the El Segundo plant continued to churn out an endless stream of ADs until the 3,180th and last was delivered just one year ago.)

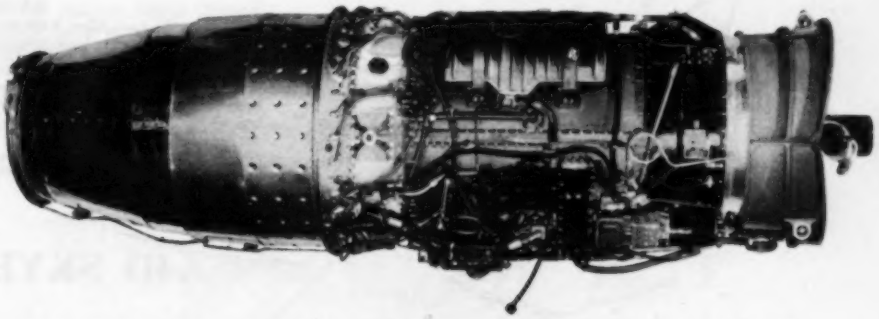
The versatility of the renowned AD is probably unparalleled, and the El Segundo team knew that they could never equal it with a jet. The primary functions for which the new aeroplane was designed were the carriage of atomic weapons and ground support or interdiction, operating both from carriers and advanced shore bases. Nevertheless, it was gradually found that the new aeroplane could, in fact, undertake such additional rôles as border patrol, gunnery training and bombing proficiency, jet indoctrination and air refuelling.

Originally, however, it was looked on simply as an "attack" aeroplane, and it was accordingly given the U.S. Navy designation A4D and the company name Skyhawk. Its history is as follows: February 1952, mock-up board inspection and start of detailed engineering; June 22, 1954, first flight of XA4D; October 26, 1956, first delivery to operational squadrons. Normally it is not permissible to divulge official specifications, but that written by the U.S. Navy for the AD-replacement called for a speed of 500 knots, a combat radius of 300 nautical miles and a maximum allowable weight of 30,000 lb. The El Segundo team decided that they

Skyhawk assembly is conducted on a single line at El Segundo. Compared with its predecessor, the AD, the aircraft has about half as many parts.



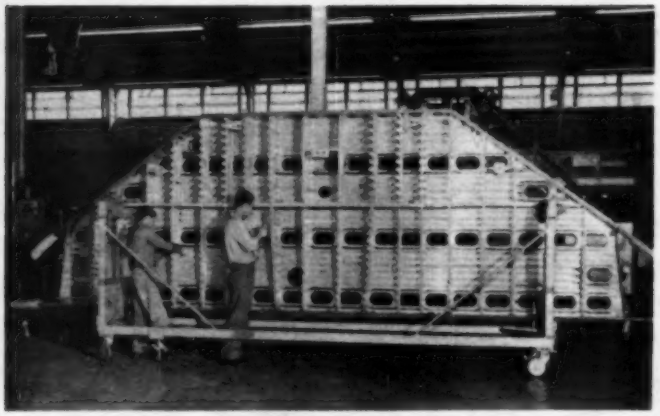
This sketch of one of the main undercarriage units clarifies the rather unusual geometry. Reminiscent of the 1940 era, it leaves the wing free for fuel and stores.



Standard powerplant of the production A4D-2 is the Wright J65-W-4 (licence-built Sapphire). This engine has a rated thrust of 7,800 lb and weighs approximately 2,750 lb. This photograph shows the A.C. generator, intake adaptor, main fuel control and saddle oil tank (both attached to the compressor casing), and the flexible pipes to the 36 vaporizing burners. The A4D-3, with a Pratt and Whitney J52 engine, has been cancelled.

could exceed the speed by 90 knots and the radius by 100 nautical miles with an aeroplane weighing exactly half the permissible maximum. The data-table on page 310 shows that they were right.

Throughout the structure the ruling material is the common 75S aluminium alloy, generally used as 7075-T6. Virtually the entire airframe is fabricated from standard sheet, strip and extrusions, and forgings have been almost completely eliminated. Possibly the most interesting part of the structure is the wing. Owing to the short span it does not have to fold, and, as the drawing shows, it forms a single box from tip to tip. This box is employed as an integral fuel tank, sealed with Minnesota Mining EC-801 compound. To reduce potential sources of leakage, and to improve the wing's fatigue characteristics, the skins are machined from extra-width sheet covering the entire wing box and measuring 27ft x 8ft x 0.064in. The spars and stringers are continuous from tip to tip, the former members being machined from 2in-thick plate and the front spar being bent in a heated die, after machining, to conform to the plan-form of the wing.



Most noteworthy feature of the airframe is the one-piece wing, which forms an integral fuel tank. In this view, the simple plate-type structure has been applied to the continuous upper skin, the latter being provided with numerous inspection holes.

There are few unconventional features in the design of the fuselage. A transport joint is provided at the strong frame in line with the intermediate wing spar; this frame also carries the engine and is a single-piece forging. An unusual feature of the construction of the forward fuselage is that heavy (0.1in) skin is used over almost the entire area. In addition to providing some protection for the pilot and equipment, this skin almost eliminates the need for interior structure, and thus increases the effective size of the cockpit. The instrument panel of an early A4D is illustrated (right). In our issue of March 1, 1957, we described the integrated flight suit designed by Douglas for the A4D pilots, and the lightweight (40 lb) ejection seat is also of Douglas design.

Details of the flaps, airbrakes, aerodynamically operated leading-edge slats and control surfaces can be seen clearly in the drawing. A novel feature is the single-surface rudder (introduced on the A4D-2), the rear half of which consists of a single sheet stabilized by chordwise members on either side. This type of surface, which is also seen on the North American FJ-4B Fury, is intended to eliminate flutter. Vortex generators are fitted over the wing ahead of the ailerons. In the A4D-1 all controls are manual, except for the variable-incidence tailplane which is pivoted at the front spar; the A4D-2 has a fully powered tail. The stalky undercarriage provides ample ground clearance for external stores and permits the aircraft to land with an angle of attack 1.2 times the stalling value. Each unit comprises a single Menasco strut hydraulically trimmed and retracted in a forwards direction, the mainwheels turning to lie flat in the forward portion of the wing.

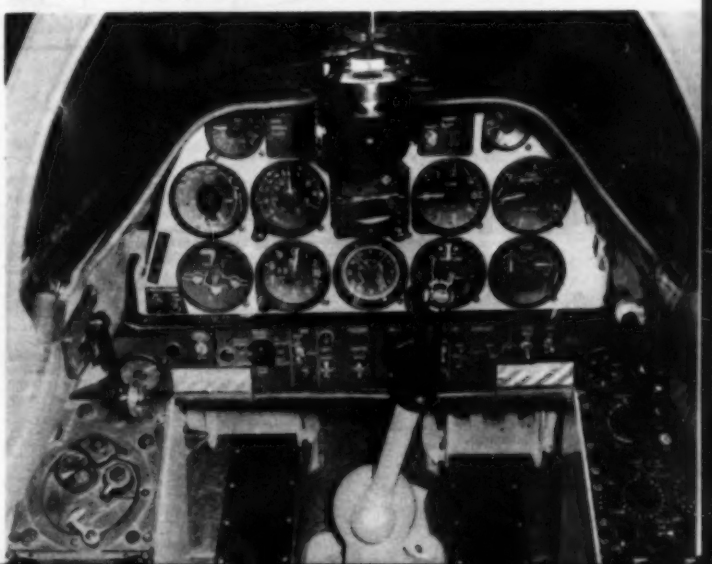
Fixed armament comprises a pair of 20mm guns located within the superficial fairing structure ahead of the front spar. To facilitate feeding, and minimize jamming, the ammunition is stored in rotating drums. This internal armament is supplemented by three multi-purpose racks, that on the centreline being stressed to carry a load of 3,000 lb and those under the wings each being rated at 1,000 lb. Several hundred combinations of stores can be carried, including HVARs, various types of H.E. bomb, tactical kiloton atomic weapons (up to 3,000 lb), Zuni or Mighty Mouse packages, Sidewinder infra-red homing missiles, Bullpup air-to-surface weapons, torpedoes or countermeasures. All three pylons can carry jettisonable tanks and the centre station is equipped to carry a 300 U.S. gal "Buddy" refuelling store. The last-mentioned store was developed by El Segundo to permit the A4D to double as a tanker. It incorporates its own ram-air turbine, hydraulic and electric systems, fuel pumps, reel and folding drogue unit. As a receiver, the A4D-2 is fitted with a refuelling probe mounted on the starboard side of the nose.

As previously noted, deliveries of the A4D-1 started in October 1956. Thirteen squadrons of -1s and -2s are now operating aboard carriers with the U.S. Navy Atlantic and Pacific Fleets, and a substantial number of A4Ds are on the strength of the U.S. Marine Corps, operating from shore bases. In operational service the aircraft has fully vindicated Ed Heinemann's philosophy of straightforward and ingenious design with minimum complication. The company claim that user squadrons of the U.S. Navy have established a figure of 26.7 maintenance man-hours per hour of flight, and if this figure is correct it is almost certainly appreciably lower than that for any other first-line combat aeroplane.

It is probable, however, that the A4D will be the last multi-purpose combat aircraft in which the concept of simplicity will be genuinely applicable. The next-generation attack aircraft for the U.S. Navy (excluding the McDonnell F4H, which is principally a fighter) will be an aeroplane powered by twin afterburning J79 engines, with a speed of approximately Mach 2 and a gross weight of 70,000 lb. This aircraft is the North American A3J-1, of which the first example should fly this summer from Columbus, Ohio. Each A3J will probably cost as much as ten A4Ds and will be capable of operation only from the mighty *Forrestal*-class carriers. Our counterpart is Blackburn's NA.39, which in certain respects can be regarded as an intermediate stage between the A4D and A3J, with some unique attractions of its own.

(A "Flight" cut-away drawing of the A4D appears overleaf)

The almost stark simplicity and functional layout of the Skyhawk cockpit, shown here, represent no mean achievement in modern design.



DOUGLAS A4D-2 SKYHAWK
(One 7,890 lb-thrust Wright J65-W-4 turbojet)

Dimensions: Span, 27ft 6in; overall length, 39ft 1in (increased to 41ft 11in when refuelling probe is extended); height to fin tip, 15ft 2in. Other geometrical data: wing area (gross), 260 sq ft; area of horizontal tail, 48.85 sq ft; area of vertical tail, 50 sq ft; wing root chord, 186in; sweep angle, 33 deg at 25 per cent chord.

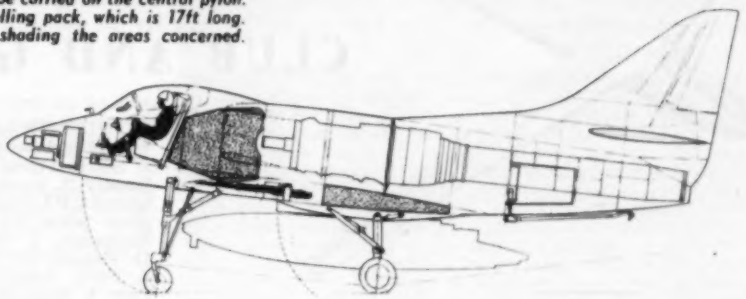
Weights: Basic operating weight, not available; normal gross weight, using petrol, 14,400 lb; maximum weight of A4D-2, using JP-4, 15,500 lb; internal fuel capacity, 770 U.S. gal.

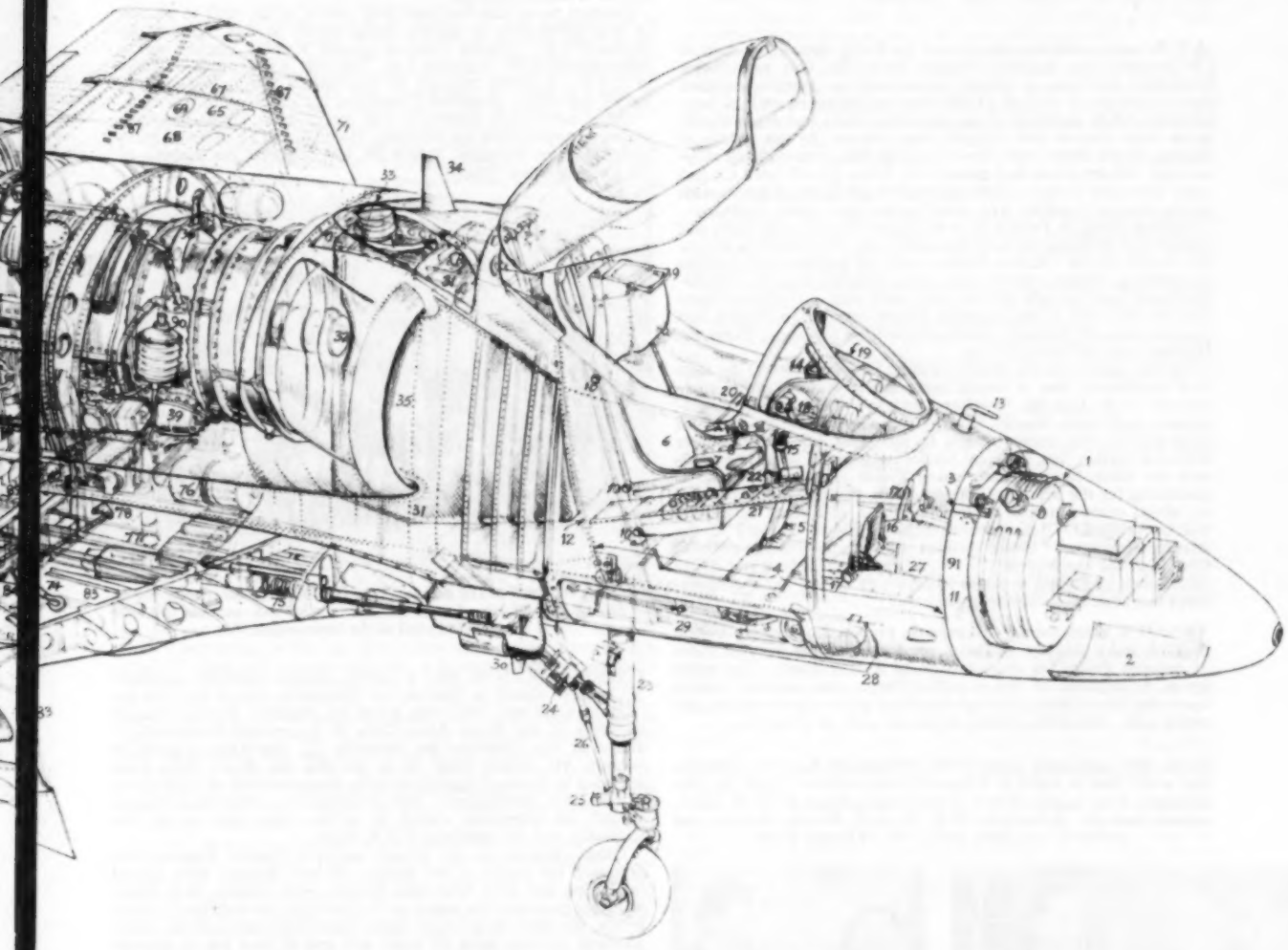
Performance: Maximum level speed, clean, 587 knots (680 m.p.h.); maximum range, approximately 1,000 nautical miles on internal fuel.

A4D SKYHAWK . . .

1 Packard-Bell packaged communications and navigation equipment
2 Dielectric panel
3 Detachable nose, two latches
4 Heavy-gauge (0.1in) skin, no stiffeners
5 Instrument panel support frame
6 40 lb ejection seat
7 Pilot release handle
8 Harness locking handle
9 Face-curtain handle
10 Six seat-rail rollers
11 Cockpit forward bulkhead
12 Cockpit rear bulkhead
13 Pressure head
14 Gunsight
15 Articulated control column
16 Hanging rudder pedals
17 Rudder control tubes
18 Left-hand console (power, undercarriage, flaps, etc.)
19 Shroud
20 Canopy control (canopy bungee-loaded)
21 Right-hand console (lighting, radio, navaids)
22 Hook control
23 Forward-retracting, pre-shortening, nose leg
24 Jack
25 Steering cylinder
26 Shortening link
27 Wheel-well blister in cockpit floor
28 Single nosewheel door
29 Equipment bays each side of leg-well (air-conditioning, control bell-cranks, fuses)
30 Aeroproducts emergency ram-air turbine, driving 1.7-kVA generator
31 Self-sealing fuel cell
32 Fuel-cell dished to accommodate 9-kVA alternator and General Electric ball-piston drive
33 Gravity fuel fillers
34 Aerials
35 Air intake to Wright J65-W-4 (Sapphire) engine
36 Engine front steady point
37 Main engine mountings
38 Oil tank
39 Accessory drive
40 Feed pipes (36)
41 Combustion section
42 Turbine section
43 Plain tailpipe (no afterburner)
44 Oil breather
45 Engine accessories access panel
46 0.008in stainless-steel shield bonded to wing skin
47 Fuselage break-frames

The drawing below depicts a standard production Douglas A4D-2 Skyhawk, powered by a Wright J65-W-4 engine. No attempt has been made to indicate underwing stores-loads (apart from a simple tank-outline on one wing), but the small inboard-profile drawing on the right, below, includes an envelope-outline for all possible combinations of stores which can be carried on the central pylon. The largest of these stores is the "Buddy" refuelling pack, which is 17ft long. The location of internal fuel is indicated by shading the areas concerned.





48 Aft-fuselage attachment bolts (4)
49 Silicone-rubber seal at firewall
50 Arrester-hook jack
51 Hook loads carried to rear spar
52 Forged frame carrying tail loads
53 Tailplane pivot point
54 Tailplane power unit
55 Rudder power unit
56 "Tadpole" rudder: central skin, external stiffeners
57 Tailplane skins: top .125in, bottom .160in, with .312in internal routed stiffener
58 Control cables in tubes
59 Air brakes
60 Single flap-actuator
61 Split flaps
62 Wing/fuselage bolts
63 Spars machined from solid plate
64 Front spar bent after machining
65 Untapered wing skin (.064in) continuous almost tip to tip
66 Z-section extruded stringers
67 Tip joint-rib
68 Entire inter-spar volume is integral fuel tank
69 Tank inspection panels, upper surface for better seal (by O-rings)
70 Automatic leading-edge slats, with fences
71 Port slat shown closed
72 Rails penetrate front spar
73 Rail container in tank
74 Retractable catapult hooks
75 20mm Colt-type gun each side
76 Feed assister drums (guns staggered, starboard gun forward)
77 Ground air (starter) socket on belly (no internal starting possible)
78 Aileron control tubes
79 Undercarriage leg mounting on bottom boom, centre spar
80 Retraction jack
81 Long-stroke pre-shortening leg
82 Breaker-strut and jack
83 Wheel bay and door
84 Leg turns 90 deg to lie in underwing fairings
85 Pylon: tank outline shown; Sidewinder or Bullpup missiles, 1,000 lb bomb, rocket packs; alternatives
86 Pylon fittings in wing
87 Turbulators (vortex-generators)
88 Servo/trim tab
89 Centre pylon: 300 U.S. gal "Buddy" refuelling unit, 3,000 lb bomb, ground starter trolley; alternatives
90 Liquid-oxygen converter
91 Flight refuelling probe; accommodation in this area

Artist's impression of the Bréguet 905, designed to comply with the requirements (15-metre span, simple construction) of the F.A.I. standard class of sailplane—a new category for the world championships.

CLUB AND GLIDING NEWS

AT the recent annual conference of the Polish Aero Club, marked progress was reported during 1957—the first year "after Gomulka" and one in which restrictions on sporting aviation were removed. A total of 41,200 powered flying hours had been achieved, while members of the parachute clubs had made 11,430 drops from aircraft and 147,600 from towers. In the sphere of gliding, 31,600 hours were flown and 118,000 cross-country miles covered. Glider pilots had gained 142 Silver Cs, 43 Gold Cs and eight Diamond badges. The club had decided to set up its own design bureau, together with construction and repair facilities.

Balloon flying in Poland is to be revived by the aero club, and a number of balloons are to be built this year. It is hoped to initiate the revival of the Gordon Bennett type of international balloon competition. Other competitions being planned include a round-the-Baltic race for light aircraft; and, next year, a challenge light-aircraft race over a long-distance course starting in Poland and passing through Bulgaria, Czechoslovakia, Yugoslavia, Rumania, Hungary and the Soviet Union.

On the subject of the World Gliding Championships, the aero club announced that it would make available for foreign competitors seven Jaskolka (Swallow) and five Mucha (Fly) single-seaters, and three Bocian (Stork) two-seaters. If the demand exceeded this, the number might be increased, but the organizers were not certain that sufficient retrieving vehicles would be available for those foreign pilots using Polish gliders. The club is producing for the benefit of foreign crews a large number of cards on which certain useful phrases, in Polish and other languages, will be printed. These phrases include "Please take me to the nearest telephone," "Please connect me with the Leszno airfield" and "Tell me the way to. . . ." An appeal to gliding and flying enthusiasts in Poland to act as interpreters during the championships has been made by the organizers.

PILOTS' notes for the Chipmunk, prepared by Surrey Flying Club and published at 2s 6d, are now available to other clubs at reduced prices for quantities of at least a dozen. The notes cover descriptions of the aircraft, systems and controls; engine operating instructions; aircraft handling notes; emergencies; and check lists. Enquiries should go to the club at Croydon.

At the 30th anniversary dinner-dance of Plymouth Aero Club, reported last week: (left to right) D. Fitzgerald, vice-chairman; Capt. Sir John Walsham, R.N., captain of R.N. Engineering College; W. H. W. Lucas, airport manager, Roborough; W/C. R. J. B. Pearse, director; and A.V-M. G. I. L. Saye, A.O.C. No. 19 Group, R.A.F.

STUDENTS from France, Germany and the Channel Isles are among those now training for their Commercial Pilot's Licences at Elstree Flying Club. The 32-week course, which began on January 28, is progressing well and plans have been made for the second C.P.L. course to begin on Tuesday, May 6. In the photograph below, the students are (standing, left to right), W. G. Rushworth, J. Salmond, T. Lonsdale, P. Kalber, G. Tong, D. Osgood, H. H. Richelsen, A. Stauber, D. Greenland and A. Privé. Seated, from the left, are P. C. Silk, chief engineer; Capt. E. Brook-Williams, chief ground instructor; W. H. Bailey, chief flying instructor; David F. Ogilvy, manager; and J. Schooling and E. Wild, instructors.

Claimed to be the first and only course of its kind to be run by any flying club or private flying school in this country, the Elstree C.P.L. syllabus features ground training carried out in collaboration with Avigation, Ltd. The cost of the course, *ab initio* to C.P.L., is £960, payable in instalments. An additional ten weeks' training is provided if required for the instrument rating.

Other news from Elstree is that the club At Home has been planned provisionally for Saturday, June 14; and an informal party at the club on Saturday, March 29, will celebrate the winning of the Lennox-Boyd Trophy.

Students and staff of the first full-time C.P.L. flying and ground course at Elstree Flying Club. As reported above, a second course of this type is scheduled to start at the beginning of May.

CONFIRMATION that a second annual sailplane aerobatic contest would be held at the Dunstable site of the London Gliding Club this year was given by Maurice Imray, aviation secretary of the Royal Aero Club, at the annual London G.C. dinner at the clubhouse on February 22. Speaking as guest of honour, Mr. Imray went on to say that the Royal Aero Club intended to be more aggressive in its representation of light flying in general in this country. The airworthiness certification of light aircraft, he submitted, should be on the same basis as that for sailplanes and for approved P.F.A. types.

Other speakers at the dinner included Dudley Hiscox, who proposed the health of the guests; Michael Riddell, who toasted the ladies, and Miss Elizabeth Watson, who replied. Ken Owen of *Flight* proposed the health of the club, and the secretary, Arthur Sweet, disclosed in his reply some intriguing aspects of the club's accounts as they were 20 years ago and as they are at present. The club, he said, had regularly paid its dues to the Kemsley Flying Trust—regularly late, but nevertheless regularly. He hoped the club would owe the Trust even more money in the future.

The annual awards were presented by the chairman, Godfrey Lee, in the absence of John Furlong, president of the club. The Dent Cup for the best flight in 1957 went to Michael Garrod, for his Skylark 2 flight from Dunstable to Plymouth on June 23. For the best job of constructional work during the year, J. M. Butt and L. J. Moulster received the Desoutter Trophy for their work on their Kite 1. Mr. and Mrs. Chuck Bentson were presented with the Derry Trophy for the best all-round job of work for the club. The Cellon Trophy for the best *ab initio* pilot was not awarded this year.

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. The names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Big-Jet Runway Requirements

THE economics of the operation of pure-jet aircraft are based on a flight plan which is unworkable today and in the foreseeable future (*vide* A. Cdre. Mann's Brancker Memorial Lecture). It would require all other traffic to get out of the way during its departure and arrival. What nonsense!

Pure-jet aircraft will not be allowed into New York State airports unless the noise level can be reduced to that of the Super Constellation (Mr. Watkinson in the House of Commons). The maximum reduction which can be achieved with current noise suppressing nozzles is 5 to 7 decibels, which is insignificant in relation to the amount of silencing necessary. Even the Conway by-pass engine holds out no hope of noise reduction to the required level (Mr. H. B. Irving, late consultant to the Director of Aircraft Research and Development, Ministry of Supply).

The runway requirements of the Boeing 707 and Douglas DC-8 have been variously quoted from 9,000ft to 13,500ft. The views of the pilots who are going to fly them tend towards the higher figure. This is not surprising when the B.E.A. accident at Munich is analysed; without in any way prejudging the issue, it would be true to say that the runway at Munich was not long enough for the emergency which occurred during the take-off.

What a prospect for the airlines which have pledged their financial future to buy these "white elephants." They will take off from runways which have not yet been built, situated in barren wastes where the noise will not disturb the non-existent population, and then divert to some other desolate spot so that they can make an uninterrupted descent clear of all other traffic.

This will be of great comfort to the passengers who want to get quickly between New York and London. Perhaps they will prefer to travel in the Britannia, which suffers from none of these inconveniences, and which is demonstrating daily its capabilities and establishing its indisputable claim to be the finest commercial aircraft in the world.

FRANK HOLT,
Herne Bay, Kent. S/L., retd.

Those Rocket Bases

FEW factors have had such profound military significance as the rapid development of the large ballistic missile with a megaton-yield warhead. As an Englishman I am not wholly disinterested to learn that by the end of the year intermediate-range weapons will actually be operational on British soil (at least they are scheduled to be). Yet try as I may to find out what is going on, I cannot penetrate the veil of half-truths, ignorance and silliness which seems to surround this situation.

It would not be unreasonable to ask the Minister of Defence what the weapon concerned will be. During the Commons debate on February 28 he implied that it would be the SM-75 Thor; but he did not say so outright, neither did he say that it would not be Jupiter. I have always regarded Jupiter as a better weapon than Thor owing to the fact that it uses air-bearing gyros (which the U.S. Army has proved reliable), it is smaller and theoretically cheaper than Thor, and above all it is more mobile and requires much less in the way of cubic yards of concrete. The U.S. Army, whose weapon Jupiter originally was, have a different mentality from the U.S. Air Force, and could not accept a weapon which was tied to vast and expensive fixed ground installations.

Please do not think I am "grinding an axe" for the U.S. Army. I am merely a not-disinterested spectator trying to find out which IRBM we shall see "mainly in East Anglia, Lincolnshire and Yorkshire," and why. I cannot understand why the four letters "IRBM" should be taken as synonymous with the name "Thor."

Moreover, I cannot really fathom the reasoning behind the decision of the British Government to produce an all-British ballistic weapon in a generally similar class. It has been suggested that the British weapon—which, according to my morning paper, if nobody else, is called "Big Feller"—will also be an IRBM, i.e., it will have a design range of some 1,500 miles. Yet this class will be admirably served by the weapons already advanced in development in the U.S.A., namely Thor or Jupiter. Why, then, should we do the same thing five years later?

The Minister of Defence persists in describing our device as "a rocket of a more advanced type." What can he possibly mean by this? I do not believe that it can be technologically more "clever" than the U.S.A.F. weapons, since in such a challenging field people who do not know, who do not have experience and who have practically no hardware or industry backing, cannot reasonably expect to be more clever than people who have.

One of the few factors about our big weapon which can be deduced with any assurance is that it (or its first stage) will be powered by one or more liquid-propellant rocket motors made by Rolls-Royce to precepts laid down by North American's Rocketdyne division. N.A.A. are first and foremost liquid merchants, and anybody who hitches his waggon to a liquid star will probably wish that he hadn't. As far as I can see, the only advantage in doing so is that one can thereby use existing designs. Clearly the most reliable big, gimbal-chamber engine is the Rocketdyne 165,000lb-thrust unit, and I imagine this is what Rolls-Royce are making. So any suggestion of a "more advanced type" must be restricted to the airframe, guidance or warhead. What is more, I'll bet my boots that we have to use an American nose-cone and re-entry body, for the simple reason that we have no facilities at all for doing our own. I have yet to find any evidence of our ability to make a guidance system of this type—or even a single inertial-quality gyro (unless it be made under licence from our friends over the water, and nobody gets "more advanced" hardware when it is built under licence).

I would dearly like to go on to the field of manned military aeroplanes and perhaps venture a very timid suggestion that the V-force won't go on for ever and that the ballistic missile can't do *everything*. But perhaps our "more advanced" device really will be able to do electronic reconnaissance, countermeasures, localized sorties, target searching, and so forth.

Small Heath, Birmingham. TAXPAYER.

Restrictions on the Private Pilot

THE letter from Mr. Bellamy [February 7] represents the view of one dissatisfied customer. That of Mr. Morton [February 21] represents a large number of satisfied customers in the busiest terminal area of Europe.

The latter invites a reply from the Guild of Air Traffic Control Officers, but we are a modest lot, and most of us are Civil Servants, so we prefer the users to blow the trumpet for us.

Mr. Morton has done this most effectively, and we are indeed grateful to him. Mr. Bellamy no doubt has his troubles. Perhaps he would care to visit one of our busy terminal areas and see some of ours.

London, W.1. W. C. WOODRUFF,
Master, The Guild of Air Traffic Control Officers.

[As we remarked last week, this controversy must now close; but we make an exception for the above letter—Ed.]

The First Enclosed Cockpit

I ENCLOSE a letter, photographs and blueprints from the Cessna concern which I hope will be of some use to you concerning the "First Cabin" correspondence. As will be seen in Mr. Deneau's letter, there seems to be a host of Cessna aircraft that appeared before Mr. Gibbs-Smith's 1927 deadline [Correspondence, November 29, 1957].

Birmingham, 14. MAURICE AUSTIN.

[The letter referred to by Mr. Austin is from Mr. Gerald O. Deneau, administrative engineer (commercial aircraft), Cessna Aircraft Co. His photograph of *The Comet* is reproduced on this page, and extracts from his letter are given below—Ed.]

"Clyde Cessna built and flew his first airplane in 1911. However, it was a single place open cockpit job and did not incorporate 'all-enclosed cockpit.' I am enclosing some pictures of these early Cessna aircraft and also a three-view drawing of Clyde Cessna's first airplane which achieved flight.

"Sometime between 1917 and 1919 Clyde Cessna built a two-place monoplane which incorporated an enclosed cockpit for the passenger. This airplane was called *The Comet*. Perhaps it might have been the basis for the statement in the book *All-American Aircraft* which referred to a Cessna light plane with an all-enclosed cockpit. The information stated in the subject book is erroneous, as Clyde Cessna did not incorporate an enclosed cockpit until around 1918."

The Cessna monoplane with enclosed cockpit (see above).

CORRESPONDENCE . . .

Murphy's Law—and Some Others

IN "Straight and Level" (*Flight* for January 10), Roger Bacon asks for details of "Laws" such as "Murphy's Law." I should like to draw his attention to the "Law of the Cussedness of Nature" (alternatively and less politely known by another title), of which the quoted Murphy's Law, and the Second Theorem of Thermodynamics, are merely trivial "special cases." The more general Law may be stated as:—

"(i) Everything happens to cause the greatest inconvenience.

"(ii) If a given phenomenon can occur in more than one possible way, Nature will select the way which, in the relevant circumstances, will lead to the fullest realization of (i)."

As an example of (ii) I quote the following, experienced by myself while in the aircraft industry. The weight of a particular wing was estimated for $t/c=8$ per cent. When $t/c=6$ per cent was requested by Aerodynamics, the weight increased as expected, due to the extra boom sizes necessary. When, in view of this, Aerodynamics retreated to $t/c=8$ per cent, the weight was found to have suffered a further increase, due to the extra skin area associated with the greater thickness.

I know of only one instance where the first part of the Law is not obeyed, namely, in the occurrence of the weak attached shock, instead of the strong. The only explanations seem to be either:—

(i) Schlieren apparatus produces an apparent rotation of the shock, making the strong shock appear in the position expected for the weak shock, or

(ii) The inclined-shock theory is incorrect, and what is thought, from the present theory, to be the weak shock is, in fact, the strong, the present theory failing to show the existence of another solution, a true weak shock.

Carshalton Beeches, Surrey. ALAN G. BROCK.

Naval Heart-cry

ON reading Roger Bacon's final words in "Straight and Level" on February 24, I thought that to "chuck the whole idea [of supersonic fighters and bombers and ICBMs] and live like lords" was an excellent idea. But please be careful to whom you broach the subject: I've recently signed on to complete my time for pension—ten years to go yet!

Bramcote, Warwicks. AIRCRAFT MECHANICIAN.

P.S.—I very much like Roger Bacon's column.

Sopwith Memories from Japan

I NOTICE that in Part IV of the article "Sopwith Tabloid, Schneider and Baby" in *Flight* of November 29, 1957, Mr. Bruce states "Japan had at least one Schneider, and Baby No. 8201 was also sent there, engineless." This short description brought vividly to mind the days long ago, as I was the first airman to fly those machines in Japan.

Japanese naval aviation commenced in 1912, and for several years Farman seaplanes were chiefly used either for training or tactical purposes, including reconnaissance and bombing tasks against the German Forces in Tsingtao in 1914. We were, of course, impatient to get new machines of better performance.

Hence, when we got a "Schneider" in February 1917, the Yokosuka Flying Station was overjoyed. As I was the senior pilot, I was ordered to test and to master it. Its take-off and quick climb could not be touched by Farmans; I felt as if I were riding an auto-cycle up a hill after being used to a push-bicycle. Sharp turns, stall turns and looping were tried by me for the first time.

This Schneider occasioned much surprise to the population, and on the third day I was ordered to fly above the dockyard and do some stunts for the benefit of workmen during their lunch-time. Afterwards the aircraft became very popular, so much so that anybody who was quick of his work was nicknamed "Sopwith."

Following the practice in the British Navy, the Japanese Navy was considering to equip all capital ships with a deck fighter and a reconnaissance machine until a proper seaplane and catapult were completed. Therefore, in order to investigate the flying-off equipment, experimental flights from the turret platform fitted temporarily on board the battleship *Yamashiro* were carried out in 1919. I was assigned to this task with a Sopwith Pup. After a few flights under different conditions, the conclusion was reached that for fighters of the Pup type, a 30ft platform was enough if there were 12 kt component wind speed.

After this experiment with a seaplane a Pup was taken on board the old battleship *Mikasa*, the flagship of Admiral Togo throughout the Russo-Japanese war. The *Mikasa* was despatched to Vladivostok for the purpose of protecting white Russians from the Bolsheviks, and the Pup was flown on the icefield nearby until the spring of the following year.

In 1921 the Japanese Navy bought a licence for the F.5 flying-boat, and began production under the supervision of Short's engineers. Also the Mitsubishi works commenced the manufacture of deck machines designed by Mr. Smith and Mr. Highland, who had been with Sopwith company.

Some British machines, such as the Short seaplane, Blackburn Swift, Parnall Panther fighter, Vickers Viking and Supermarine Seal, were purchased for experimental purposes.

When the Master of Sempill and his mission came to Japan in 1921, a number of Avros and Sparrowhawks were imported, and Japanese naval pilots were educated with those machines according to latest British methods.

In 1916 I was sent to England, and entered the Kite Balloon Training Establishment at Roehampton, going afterwards to Cranwell, where I studied the S.S. airship and flew landplanes such as Avro, B.E.2C, B.E.2E, D.H.4, D.H.9, Sopwith Pup and Camel. I spent five interesting and instructive months at Cranwell.

Tokyo. TORAO KUWABARA
(Ex-Japanese Naval Officer).

Naming the New Airliners

NOW that details have been published of the new jet airliners for B.O.A.C. and B.E.A. perhaps the time has come to consider names for these fine aircraft.

Might I suggest: the Vickers VC.10 Viceroy; the Avro-Bristol 200 Accolade; the D.H. 121 Talisman or Albatross?

Ickenham, Middx. H. T. F. GREEN.

FOLLOWING on the Britannia, what better name for the VC.10 than Victoria? There was a Vickers Victoria in the early 1920s, and a Vanguard, too.

London, S.W.5. GEOFFREY DORMAN.

German World War I Rarities

IN his letter published on February 21 Herr Nowarra of Berlin refers to the Siemens-Schuckert G.III as being the only tractor biplane with two fuselages designed in Germany. Similarly Mr. Bruce draws attention to the Ago series of single-engined pusher machines. I am surprised that neither of these acknowledged authorities has mentioned the Fokker G.I.

I have a photograph of this machine showing it to be a three-seat biplane with twin fuselages. The central nacelle carried two Oberusel rotary engines—one mounted as a tractor, the other as a pusher. I believe it was completed in 1915, but I have no record of its ever having been used at the Front.

Brentwood, Essex. F. SMITH.

Scapa History Wanted

I HAVE recently been delving into the history of the Supermarine Scapa flying-boat. The Service career of the Scapa seems ill-recorded, publicly at least. Apparently it was used by Nos. 202, 204, 228 and 240 Squadrons and withdrawn from front-line service in the winter of 1938. It was not declared obsolete until July 1941 but I can find no reference to its wartime service. I wonder if any of your readers can shed any light upon the Scapa?

Cambridge. M. J. F. BOWYER.

[Letters will be forwarded—Ed.]

FORTHCOMING EVENTS

Mar. 7. Helicopter Association: "Some Ways of Obtaining an Integrated Aircraft," by Dr. D. Kuchemann.

Mar. 9. Nairobi Airport: Air Display for Official Opening.

Mar. 13. R.Ae.S.: Main Lecture at Christchurch Branch: "Flight Tests of a Meteor Aeroplane fitted with Jet Deflection," by P. F. Ashwood and D. Lean.

Mar. 14. B.G.A.: Annual Ball.

Mar. 20. R.Ae.S.: Guided Flight Section: "Problems in the Development of a Guided Missile," by J. Clemow.

Mar. 21. Institute of Navigation: "The Effective Utilization of Airspace," by E. J. Dickie.

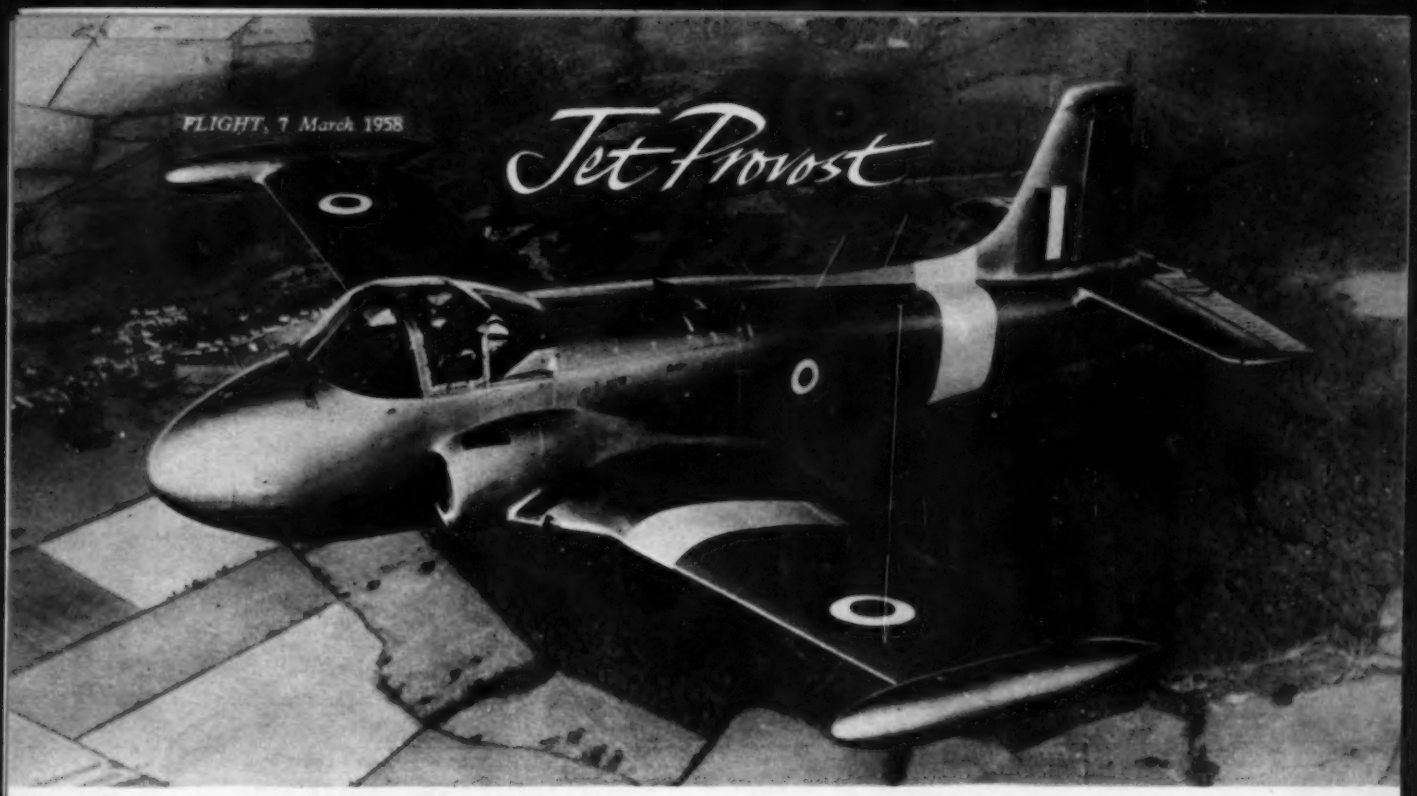
Mar. 25. R.Ae.S.: Graduates' and Students' Section: Annual General Meeting, followed by Film Show.

Mar. 27. R.Ae.S.: The Thirteenth British Commonwealth Lecture: "Why Airlines are Hard to Please," by B. S. Shenstone, at the Institution of Civil Engineers.

Mar. 27-28. Institution of Electrical Engineers: Radio and Telecommunications Section: Convention on Radio Aids to Aeronautical and Marine Navigation.

R.Ae.S. Branch Fixtures (to March 27):—

Mar. 10, Halton, "Supersonic Aircraft and Missiles," by P. J. Duncton. *Mar. 11, Boscombe Down,* "Navigation and the Air Traffic Control Problem," by D. O. Fraser; *Glasgow,* "Next Generation of Civil Aircraft," by G. H. Lee. *Mar. 12, Chester,* "Investigation of Aircraft Accidents," by E. L. Ripley; *Gloucester,* "Problems of the Large Helicopter," by Dr. G. S. Hislop; *Southampton,* "Future Developments with Satellite Rockets," by L. R. Shepherd; *Swindon,* A.G.M. and Viscount films; *Weybridge,* "Aircraft Production; Present and Future," by S. P. Woodley. *Mar. 13, Christchurch,* Main Lecture (see above). *Mar. 17. Bristol,* Barnwell Memorial Lecture, "The Economy of Structures," by Sir Alfred Pugsley; *Henlow,* Film Evening. *Mar. 19. Leicester,* "Aircraft Photography 1913-1957," by John Yoxall. *Mar. 20. Cambridge,* "The Pioneers," by N. J. Capper; *Isle of Wight,* "The Development of Powerplants for Supersonic Flight," by Dr. E. S. Moult, J. Edwards and W. Neat; *Yeovil,* "A Review of Private Flying" by A. Elsmore. *Mar. 21. Birmingham,* A Talk on Astronomy, by M. W. Ovenden. *Mar. 25. Luton,* A.G.M. and Presidential Address. *Mar. 26. Hatfield,* "Civil Airworthiness and the Air Registration Board," by R. E. Hardingham; *Preston,* "American Production Methods," by A. W. Turner. *Mar. 27. Bristol,* A.G.M. and Film Show; *Glasgow,* "Application of Electronic Control Techniques to Aircraft."



Two years' service with the Royal Air Force has established the Jet Provost ab initio/basic trainer as the best aircraft for its purpose, and the Mk 3 powered by one Armstrong Siddeley Viper Turbo Jet is now in production for the re-equipment of Flying Training Command.

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An open letter

From: Air Marshal Sir John Whitley, K.B.E., C.B., D.S.O., A.F.C.

AIR MINISTRY (FR18),
ADASTRAL HOUSE,
THEOBALDS ROAD,
LONDON, W.C.1.

Dear Sir,

Suggesting a career is always a big responsibility - not least for parents with a son growing up. In the final analysis, the choice must lie with your son himself. But you can help him in his choice.

Here, therefore, are some facts about one career which is particularly attractive to an ambitious young man. I refer to a flying career in the Royal Air Force, about which there seem to be some misconceptions, at present.

First, let me assure you that flying will continue in the Royal Air Force for as far ahead as can be foreseen. The Royal Air Force has the prime responsibility for the air defence of this country. For young men therefore who are trained to tackle the problems of the air in the air, there will be more - not fewer - opportunities in the missile age. This is especially true of those who qualify now for a permanent or short service commission and come successfully through their Pilot's, Navigator's or Air Electronics Officer's training. In a service as complex and as forward-looking as the Royal Air Force, there is always a constant demand for the right kind of senior officers.

The new increases in pay and allowances effective from the 5th April mean that a Flight Lieutenant of 25 can, with full allowances, earn more than £1,500 a year. It is a job of high responsibility. Quite apart from flying and its fascinating skills, there are the manifold duties of an officer; to men under him; in staff, liaison or training jobs; and perhaps, in high command.

You know yourself if your son has the character, intelligence and fitness for this magnificent (but exacting) life. If he is over 17½ and has G.C.E. or equivalent to the required standard, you may be doing him a service if you write to the Air Ministry for fuller information.

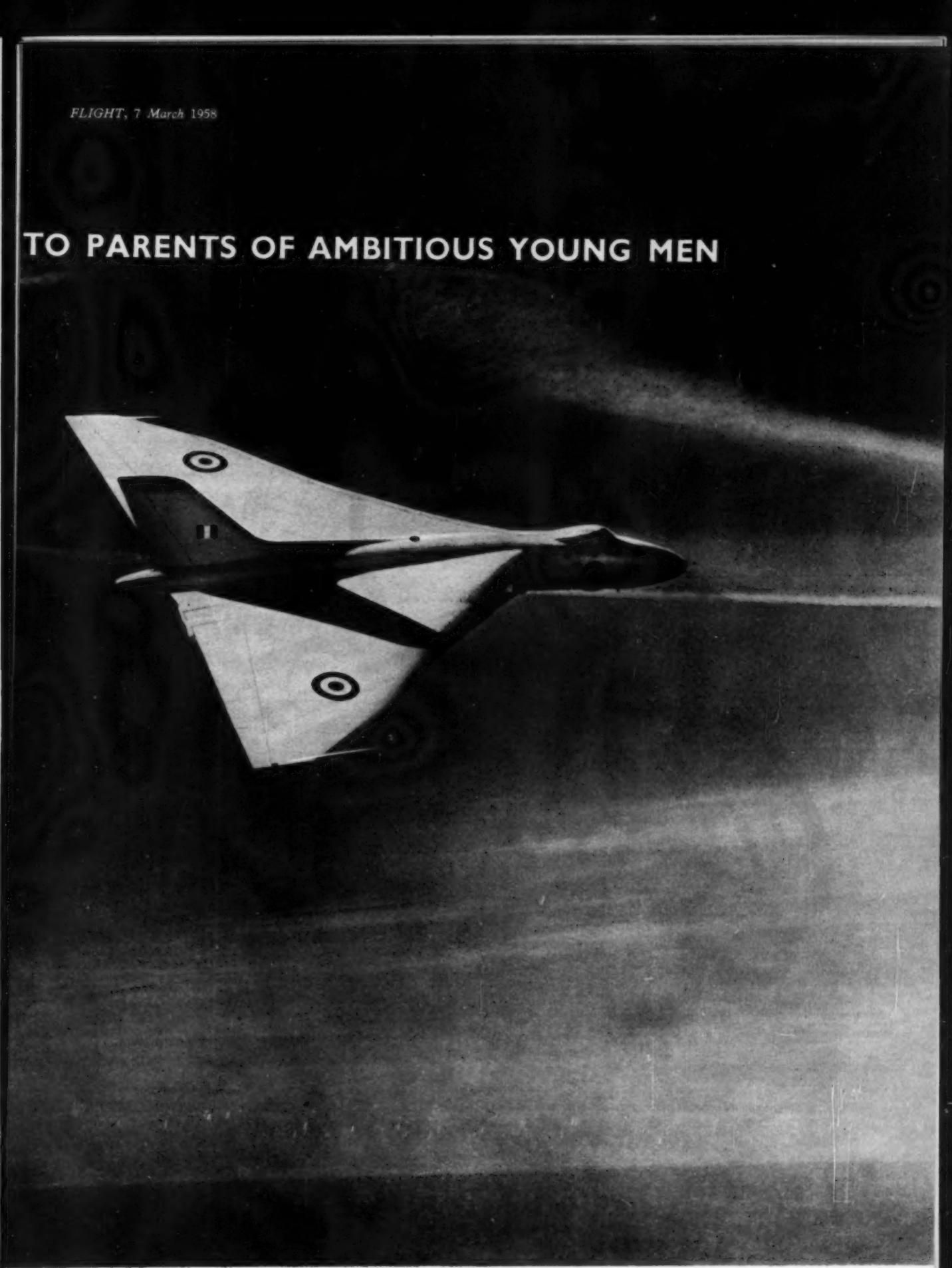
Let me add that the country needs the right kind of young men for this vitally important job, and it needs them now.

Yours faithfully,

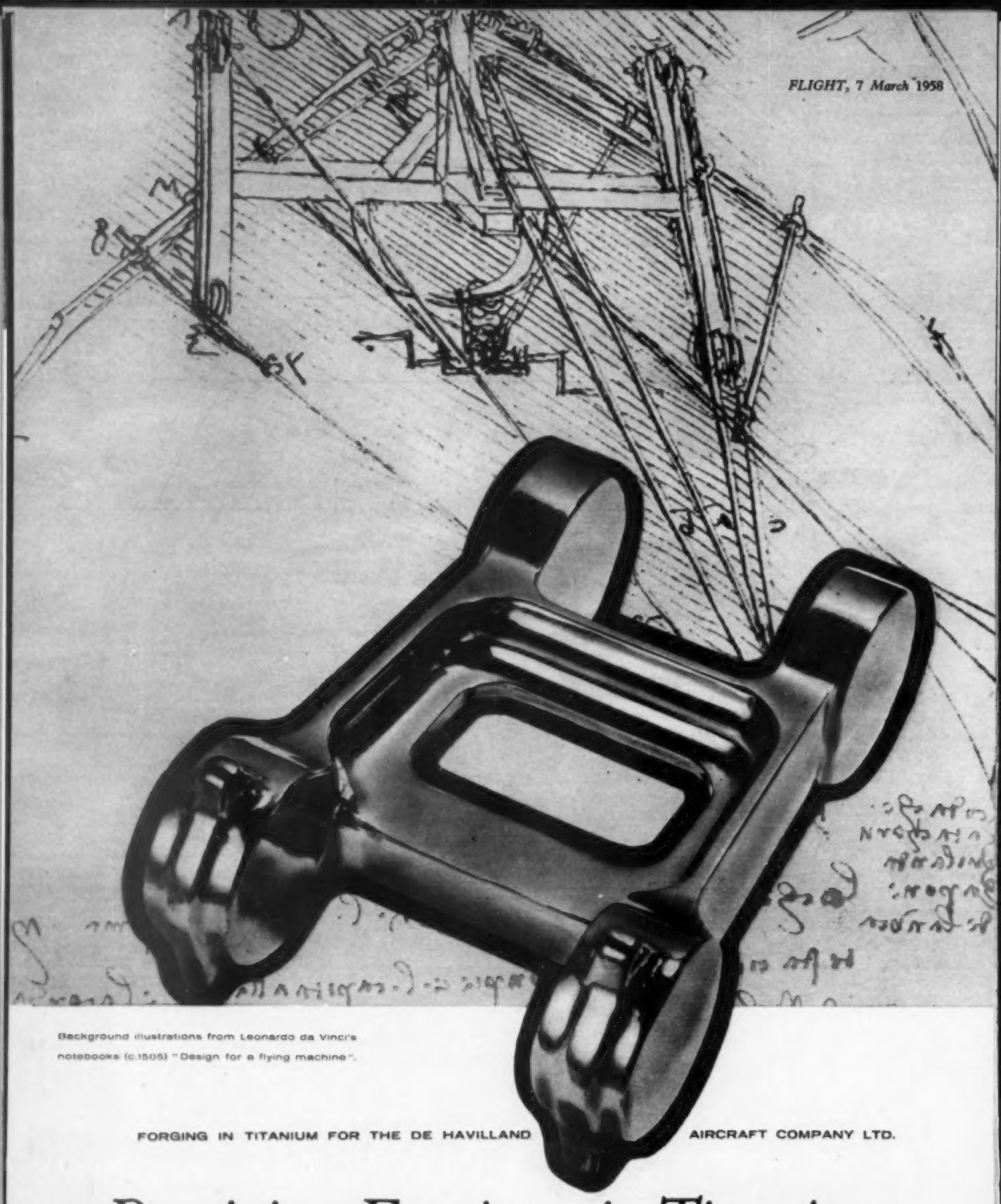
Air Member for Personnel

To any young man who wants to fly . .

TO PARENTS OF AMBITIOUS YOUNG MEN



For further information write, stating age and educational qualifications, to : Air Ministry (FR18), Adastral House, London, W.C.1.



Background illustrations from Leonardo da Vinci's notebooks (c.1505) "Design for a flying machine".

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Straight and Level

I WANT to hand a small bouquet to A.W.A., which stands for Sir W. G. Armstrong Whitworth Aircraft. Several recent A.W.A. achievements deserve it, but this one is for the overall manner in which the company are handling their A.W.650 transport programme. First, they have published a detailed schedule of what will be done and when. Second, they know what their market is; they are really interested in that market; and they are not basing their design on a hunch by the board or a world-wide trip by a sales executive who stops off at every operator, sees one man and says "four engines or two?" Third, they are bringing everybody in on the ground floor; B.A.L.P.A., for example, really have had a finger in the pie with the 650 flight deck. Fourth, the whole Hawker Siddeley Group are marshalling all their mighty resources to build and develop the 650; it is almost the first British aeroplane in recent years to enjoy a design and engineering strength, both in men and facilities, fully equal to that applied to comparable programmes in the U.S.A. Finally, A.W.A. are keeping every interested person fully informed. These factors add up to one thing: this is the Group's firm entry into the civil market, and they are showing everybody how such a programme should be undertaken.

● All other things being equal—which, of course, they never are—it's always better to make an aeroplane pressurized, if there is any choice at all. Even DC-3s could do a far more competitive job if they had a pound or two of pressure differential, and pressurization even helps in the carriage of several kinds of freight—quite apart from being essential to the high-altitude transportation of live animals. A typical, and unexpected, disadvantage of the unpressurized freighter is that it cannot carry wool unless the cruising altitude is held below about 8,000ft. Exposure of bulk wool to ambient conditions above this height results in a loss of about half the weight of the shipment.

● Going on from the above I have been led to wonder whether we couldn't eliminate some of our present complex pressurization systems and rely on ram pressure (obtained from simple forward-facing intakes). At 400 m.p.h. at 20,000ft a theoretical maximum pressure of 3in of mercury can be obtained by this means—i.e., about 1.5 lb/sq in. But at 600 m.p.h. the recovery can reach a ratio of almost 1.6, sufficient to maintain a cabin altitude of about 7,500ft at a true height of 19,000ft (dP greater than 4 lb/sq in), and at the present world speed record of 1,207 m.p.h. (subject to homologation, as the F.A.I. says) one could hold sea-level pressure right up to 42,500ft. At sea level the theoretical ram pressure in the cockpit could have reached 180 lb/sq in!

● Yet a further thought arising out of this is what would happen to certain fast aeroplanes if they should suddenly be deprived of their windscreens. In practice, of course, the airflow around the nose and cockpit invariably gives rise to substantial negative pressure, so that—particularly at high altitude, with the cockpit pressurized—loss of the windscreen would mean drastic reduction in interior pressure. There are, however, theoretical conditions which, if met, cause the pressurization and ram pressure to cancel each other out. For example, an aeroplane doing Mach 1.05 at 17,500ft can generate a full-recovery ram pressure of 15in of mercury, just the same as the ambient pressure. Adding both together one is left with a cockpit pressure of 30—the same as at sea level. It should, therefore, be possible to work out a flight-plan whereby, through increasing speed as height is gained, it is possible to maintain sea-level conditions inside *and* eliminate the windscreen (I think).

● Do you recall my pictures of January 24 illustrating the car fin-styling cult? American car-body stylists, influenced by the aeroplane, added fins; aeroplane paint-scheme stylists promptly painted mock fins on their real fins.

Now look what's happened: the Cessna 180 seen below has a mock air-intake on its flank, in imitation of the Cadillac Eldorado, whose mock side-intake was in imitation of I don't know what.

Soon, Jupiter and Thor will have imitation twin-headlamps and radiator grilles as a logical follow-up to the new Pontiac convertible, seen in my other picture with rocket and shock-diamonds, all in rich gold and chrome plate.

I suppose the ultimate absurdity would be a Caravelle with a third jet painted on it. Actually that wouldn't be so silly, if it led Sud-Aviation to make it real, as I feel they eventually will. They have already thought about it, as you can see in the Civil Aviation section of this issue. In the meantime, the French have really hit the short-haul jet jackpot with the Caravelle.

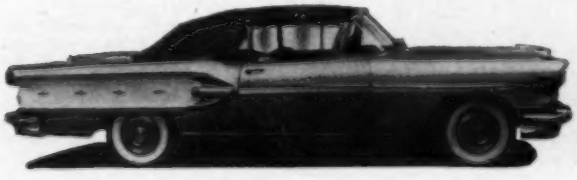
● In our issue of June 14 last year we published an article by Alan Yates entitled "Accuracy and Commonsense." In it he made the point, so obvious, but so often overlooked, that what usually matters in most walks of life is to get a quick approximation. Every day a million—yes, I mean that—man-hours are thrown away by people trying to get accurate answers to simple sums. Housewives working out budgets, project designers laying down the initial wing-area equations, economists studying the world's income-groups, all need a reliable answer correct to plus or minus perhaps 20 or 30 per cent. Nine times out of ten they spend a whole day collecting data and another six hours trying to get a result correct to six places of decimals, completely overlooking the fact that half their data figures are only very rough approximations to start with. As likely as not they will make a slip somewhere and end up with ten significant figures and the decimal point in the wrong place.

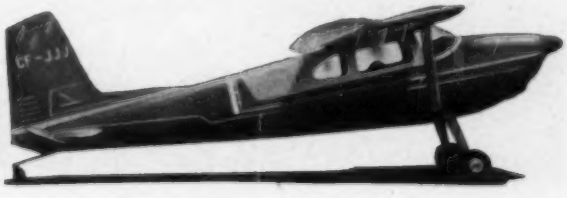
What one must at least try to do is to obtain a picture of what the answer is likely to be (although even this can sometimes be dangerous). The good engineer can merely look at a problem and say "the answer is between 45 and 50." The next-best man does it with a slide-rule, and takes a bit longer.

Which reminds me, you have to watch those slide-rules; I just divided 68 by 17 and made the answer 3.95. This sort of thing is done every second of every day.

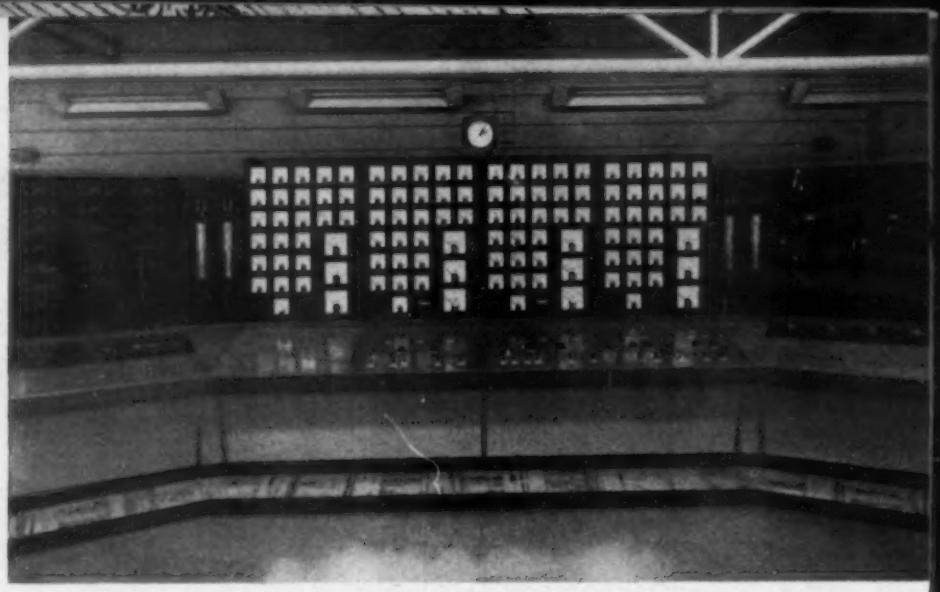
● Most idealists mean well, but I am sure there is no place for them in a modern aircraft industry. If your industry is run by practical men the result is a lot of imperfect aircraft doing a useful job; but if you have too many idealists the result is a lot of equally imperfect aircraft doing no useful work at all.

ROGER BACON





ROTAX LOOKS AHEAD



RELIABILITY THROUGH RESEARCH

ONCE in a while every engineering firm must close the door on the busy production machine-shop, the mute activity of the design and drawing offices and the throbbing tempo of the test-beds and laboratories; must metaphorically put its feet on the table and give serious thought to what lies around the corner of tomorrow. Now, while perplexing and disturbing changes are running through the aircraft industry, is such a time; and in conference and discussion at every executive level the industry —the accessories industry not least—is forming the pattern it will follow for the next few crucial years.

New challenges bring new responsibilities; and in this appraisal of the work of one of the leading electrical firms in the important ancillary industry *Flight* offers an assessment of the contribution that Rotax, Ltd., hopes to make to the generation of aircraft that are now in the project office, on the drawing board and on the factory floor. This firm devotes almost its entire output to the needs of the aircraft industry, and the exceptions—a starter for the Meteor tank engine or the recirculating-ball precision screw-jacks now supplied commercially in any length up to 6ft—are fringe sales of essentially aircraft work. The Rotax design and test facility is at Willesden, in North-West London, and the production and development factory at Hemel Hempstead, Herts.

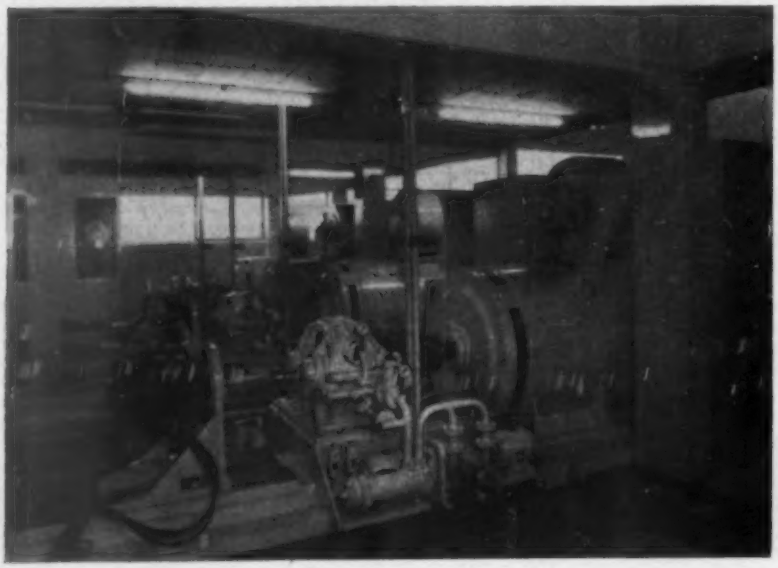
It seems unlikely, even now, that the change of engineering emphasis between structure and systems is yet sufficiently appreciated. Perhaps phrases of the *genre* "systems concept" and "integrated systems" still have a hollow, exaggerated ring, selling an idea in advance of its realization. Yet the importance of the hydraulic, pneumatic or electrical systems in the functioning of an aircraft as a whole is clearly becoming obvious; some sharp lessons of the past year have driven that much home. So much so, indeed, that the reliability of such systems on civil transports in service easily outweighs in importance and occurrence minor development troubles that the aircraft manufacturer may experience with his structure. Every increase in comfort, or convenience or efficiency is matched by more systems and more components to do the job. The systems are not the whole aircraft, but in complexity they are now the major part.

The change that has come about is that the aircraft manufacturer is now concerned—and responsible—to a hitherto unprecedented degree for the system arteries of the airframe, and it was this new relationship between constructor and contributor that was the theme of some of our more sombre Christmas thoughts (in *Flight* of December 20, page 946).

Yet wherever component responsibility is agreed to lie, it must always, eventually, be delegated to the accessory manufacturer responsible for design and development. Thus at Rotax, a new systems-laboratory has recently been added to tackle the difficult and pressing problems of foreseeing the snags that will arise when many electrical components (and not all of them from the same manufacturer) are conjoined into a system and asked to work over a growing environmental envelope.

Directly applied to these problems is the aircraft electrical systems test laboratory at Hemel Hempstead—a soundproof glass and brick building carried on reinforced concrete beams over the motors and generators in the test cell. Work in this laboratory is confined to systems comprising generators, alternators, switchgear, transformer-rectifiers and so on that have already been individually tested and developed elsewhere. This is a *systems* laboratory and it is the arrangement of the components and their behaviour under simulated aircraft loading and operation that is under analysis here.

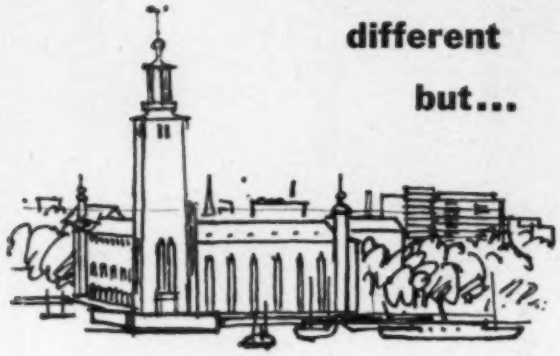
The laboratory is not brand new; in fact, Rotax claim that it was at least among the first, if not the first, to be operated in this country: it has been running about 18 months. On the ground floor are four Ward-Leonard sets of 225 h.p. series induction motors and D.C. generators (provision has been made in the cell floor for a further two sets if the need arises) which drive variable speed D.C. motors with an output of 102-170 h.p. The output, taken through a 5.55 : 1 step-up gearbox provides, say, 170 b.h.p. at 3,300 r.p.m. to the generator or alternator on test, but 10,045 r.p.m. are available if required. Mounted in the output of one drive at the time of our visit was a Rotol gearbox from an Armstrong Siddeley Double Mamba, with two Rotax alternators mounted on it side by side. The electrical output information from these—or from any machine under systems-test —is channelled and led up into the laboratory above the motor cell, and so also is temperature information from six thermocouples per drive.

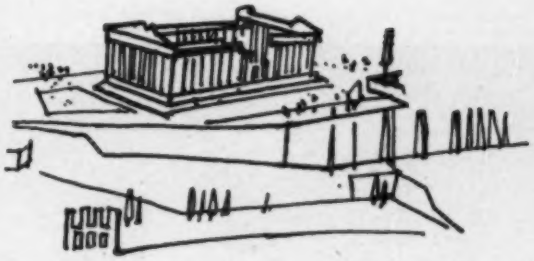


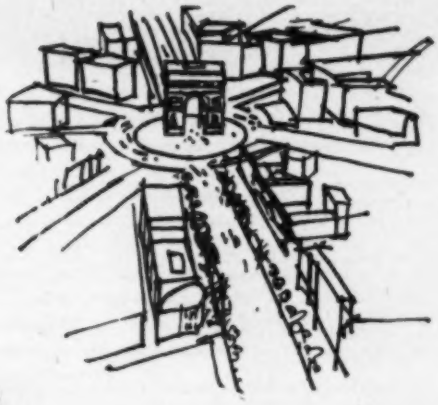
Permanent control consoles in the laboratory give remote selection and operation of the system under test and the output of each electrical machine is wire-fed to busbars and then to mat-type A.C. and

The heading photograph illustrates the main control console of Rotax's electrical systems laboratory at Hemel Hempstead. On the left are the power supplies for the same laboratory. Each variable-speed motor (supplied from the D.C. cubicles on the right) is coupled through a gearbox to provide a drive at up to 10,045 r.p.m.

The landmarks may be different but...







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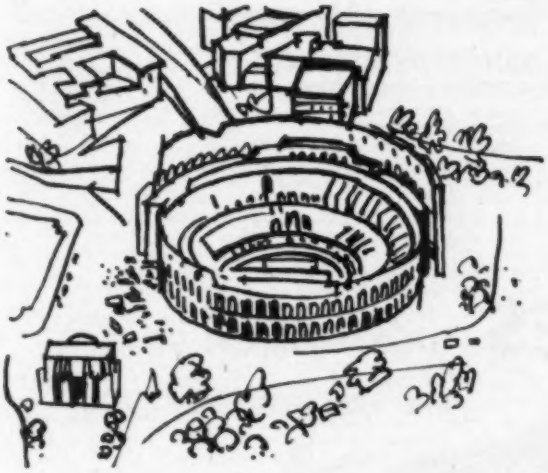

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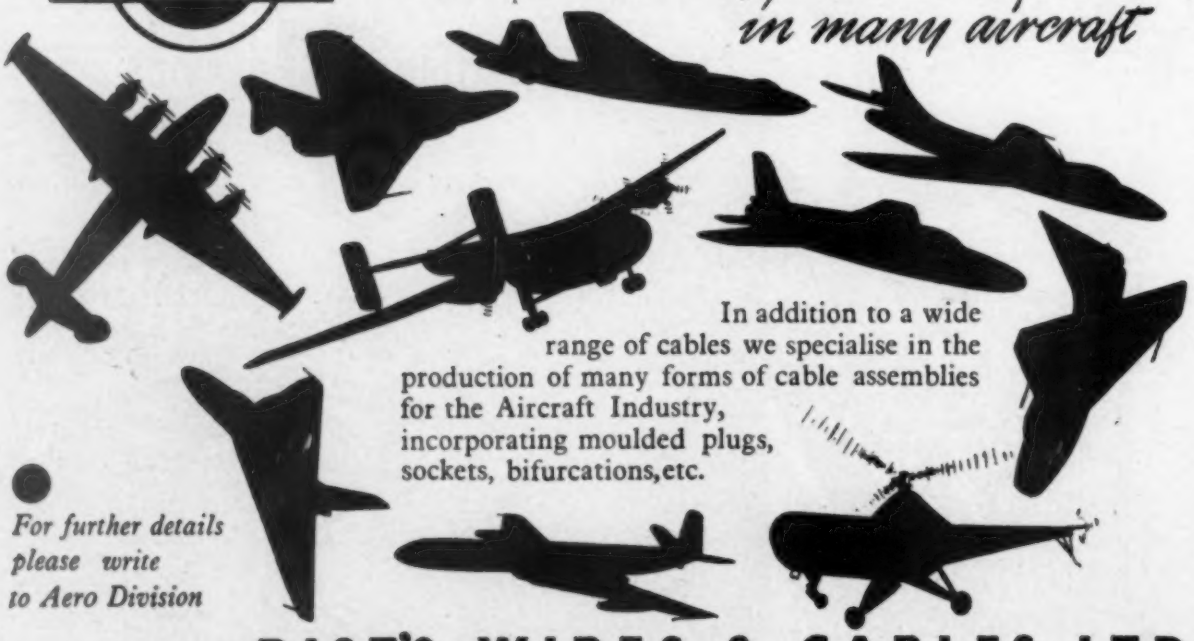

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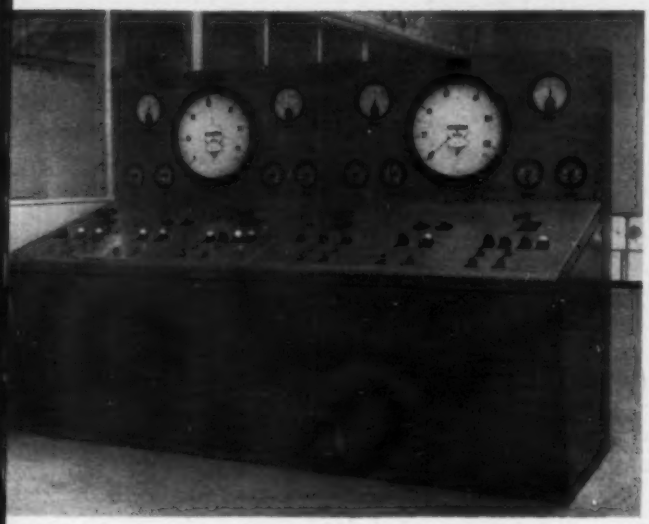


The generator- or alternator-driving motors in the systems laboratory are controlled from these desks above the motor cell.

ROTAX LOOKS AHEAD . . .

D.C. load banks dissipating their heat in an overhead gallery. Under the watchful eye of a recording camera is the main instrument information panel. Switching and warning lights are neatly laid out on polished boards to parallel closely those of the cockpits for which they are intended. To a further panel is bolted the remaining components of the system—inverters, rectifiers, transformers and so on—that are the inevitable paraphernalia of present mixed A.C. and D.C. systems.

Once the system is set up in this way, and values for the electrical loads obtained or calculated from aircraft-company information, a straight test of the system—proof of the circuit diagram—can begin. This is simply a routine test before the next exacting and difficult task; simulating various faults that might occur, and attempting to foresee unusual accidents or occurrences—water or oil running into a blast cooling duct, a spanner left across a pair of busbars or perhaps inadvertent mishandling of the electrical system by the aircraft crew. An extensive programme of tests is arranged in a conference between Rotax, the aircraft manufacturer, the operator, other equipment manufacturers, and the Ministry of Supply and A.R.B.

A typical test example might be the case of a medium-voltage regulator, the trimmer of which is open circuited. It might be decided in the laboratory that the probable result of this condition will be a slight rise in the voltage at the M.V. busbar, and that it is unlikely that the over-voltage protection will operate. Oscillograph tests are conducted according to a pre-arranged programme: a check on the M.V. load sharing current, the M.V. and L.V. busbar voltage, 50 c/s. time base and the alternator rotor current. The oscillograph is photographed and the results analysed from the developed oscillograms. The results may be just as they have been predicted; or perhaps the voltage does rise higher than was thought, and the over-voltage protection does operate—then the implication must be considered and the system and components re-analysed and changed if necessary.

The value of this type of testing is hard to over-estimate, and it becomes progressively more useful as military and civil operational knowledge is fed back into the laboratory. Human ingenuity being what it is, there will always be ways of failing components that have not been previously foreseen; but as the knowledge of the laboratory increases these should become progressively fewer.

The reputation of any electrical manufacturer must depend very largely upon the reliability of the *system* he provides. There can be no ducking responsibility by electric equipment supplier X because aircraft manufacturer Y includes other electric equipment from Z, and the system fails in service. In the systems laboratory the performance of every unit in the circuit can be checked as part of the system, although extended ground running must be done on other, individual rigs and in the various component manufacturers' laboratories.

A quite essential adjunct to systems testing is the ability to run a range of environmental tests upon both new units and new systems. While environmental testing is intended to assist pre-production development, it is necessary to be able to carry out a certain amount of *basic* development—something between pure research and production testing—that is invaluable to the component designer, whose appetite for such information is quite insatiable. There is also a temptation to get involved in extravagantly long programmes of research when this is not being done elsewhere; for example, when Rotax undertook a research programme into the brush wear on generator commutators at altitude, they relieved the R.A.E. of a large part of the work load imposed by every electrical manufacturer in the country, all anxious to find answers to the big problem of D.C. generation. Further reference will be made to this later.

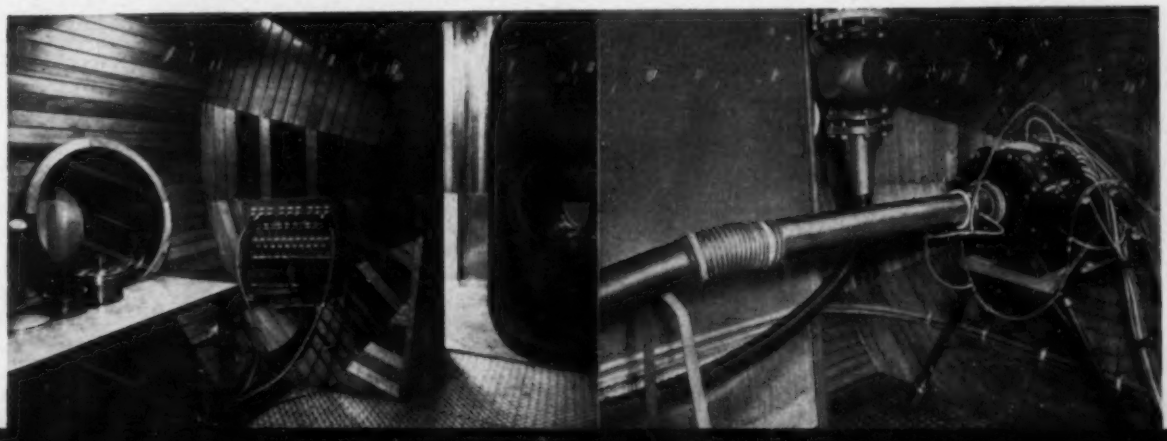
The Rotax environmental test laboratory has been in operation for nearly four years. Freon 12 refrigerant is used to reduce the temperature of the sea-level chamber to −70 deg C and of the altitude chamber to −65 deg C. The latter chamber can be evacuated down to 2.1in Hg absolute or about 60,000ft with 30 lb/min blast-cooling airflow. The environmental limits are an equivalent aircraft speed of Mach 1.2 at 36,000ft, and a humidity frost point of −82 deg C. It takes about two hours to reduce the temperature to −30 deg C and about seven to −65 deg C. A drive transmitting up to 200 h.p. passes into the chamber through a special seal.

Two main development problems are tackled in this laboratory. Any aircraft manufacturer quite rightly wants to know what electrical load can the generating machine supply, driven at what speed, at what altitude, with how much cooling airflow, and with what pressure drop and temperature rise? The laboratory engineers relate these six variables into three homogeneous curves from which the electrical load permissible at any steady state condition can be read off. The problem of cooling is to obtain a satisfactory air distribution throughout the machine and so a correct level of temperature. The brush gear and commutator or A.C. stator are likely hot-spots which must be carefully cooled if reliability is not to suffer, and a good deal of protracted running and temperature measurement must be done to prove a unit. Above about 30,000ft, self-contained fan cooling becomes ineffective and blast cooling is required. Spring pressure and commutator or slip-ring concentricity must be carefully controlled for consistent results to be obtained. It has been found important that the environmental conditions—and representative rates of change—should be simulated as closely as possible if development testing is to show up the otherwise unpredictable snags.

Brush wear at altitude, as is now widely appreciated, has proved to be an exasperatingly intractable problem. Some authorities believe that if it could soon be resolved the trend towards brushless alternators and A.C. systems might be halted; there is still plenty of support for the continuation of the well-developed and well-understood D.C. system.

Plain carbon brushes can wear as much as 1½in an hour at altitude. What happens is best described by reference to Fig. 1. Normally, the pick-off brushes do not run on the copper of the commutator, but on an oxide film; this is formed by moisture in the atmosphere trapped under the inevitable irregularities of

These two views of the Rotax altitude chamber show (left) the porthole and entrance door and (right) a typical test installation with cooling air ducted to the alternator and warm exhaust air ducted clear of the chamber. A 200 h.p. drive is available for testing the largest machines.



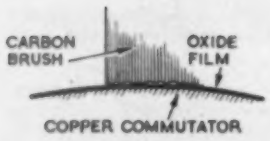
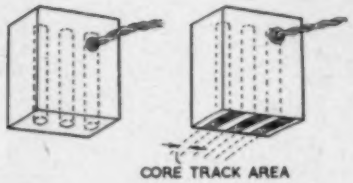


Fig. 1. The lubricating oxide film on a commutator breaks down in the dry air at altitude.

Fig. 4. Generator brushes with adjuvant cores. Tracks of carbon and adjuvant form at altitude.



ROTAX LOOKS AHEAD . . .

the contact face of the crystalline-structure carbon brush. At altitude, where the air is dry, the film does not form, and the unlubricated brush bears against the copper surface of the commutator, which becomes a very effective grinding wheel.

The most successful approach to overcoming high brush temperature and high wear has been to add to the brushes cores of adjuvants, such as varnish, barium fluoride, P.T.F.E. or molybdenum disulphide, of which the last named has perhaps been the most successful. Some of this work implies pure research, but much is still essential development for satisfactory high-altitude functioning of existing equipment. Rotax's brush suppliers, The Morgan Crucible Co., Ltd., manufacture cored brushes and carry out limited altitude tests and friction measurements. While this work provides useful information, the searching test of a new brush design is its performance in a machine, and current density, spring load and airflow temperature rise must all be checked in the Rotax chamber (the R.A.E. have devoted, and continue to devote, much time to this problem). The molybdenum disulphide cored brushes have been successful in reducing brush temperature, but still pose wear problems at altitude; they are not yet really suitable for the long overhaul periods of civil aircraft. About 0.001in wear per hour is a reasonable aim.

There are still a number of unsolved problems with cored brushes, and their behaviour is not yet completely understood. The sketch in Fig. 2 shows the wear characteristics at ground

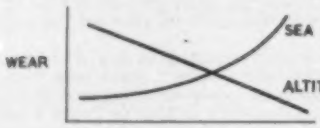


Fig. 2. Brush wear against core track area and height.

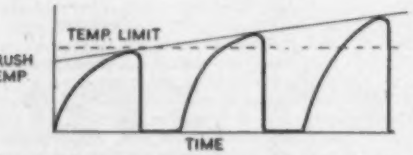


Fig. 3. Three runs at altitude on the same brush.

level and at altitude, although unexplained inconsistencies have occurred in the measured values at altitude. An interesting phenomenon is that the rate of wear increases with time, but stabilizes after about six hours. These curves also reflect the manner in which the lubricant cores become effective as the operating height increases; at ground level the oxidant film reduces the need for the molybdenum disulphide cores, but at altitude, the larger the core track (the area swept by the core) the lower the wear becomes. And although in this condition the pure carbon tracks apparently conduct no current at all (the surfaces of the brush show no sign of electrical erosion) the brush retains its effectiveness by conduction through the carbon in the core track area; it appears that the ends of the cores (which are more resistant to wear than the brushes) become filmed-over with carbon. The conduction path to the brush-lead is the carbon in the track area surrounding the lubricant core (see Fig. 4).

Rotax report some success in reducing brushwear by rhodium plating of the commutator (the Dalic plating process), although in the laboratory it has been found that under certain conditions the plating has stripped away.

It is clearly apparent that this important work must involve a considerable amount of test time in the altitude chamber, and a second, smaller, altitude chamber has been constructed to operate within the sea level cold chamber where soak testing is performed. R.A.E. pioneered high-altitude cold chamber electrical component testing in this country, and Rotax were the first private company to provide facilities for similar test work. So valuable has this proved that chamber capacity has become hard-pressed to keep ahead of production. This is not an indictment of Rotax foresight, but it does highlight the ever-present need for a great deal of ideas research at the design stage.

Long overhaul lives and very few modifications is the aim of every component manufacturer in the country, but the conflicting pulls of early delivery dates, low first cost and early large scale production test work must not be allowed to get out of hand: everyone is familiar with the designer who can never release his drawings to the shops because he has thought of something better. Yet there is still a need for larger test facilities that can do more essential work in less time; this is part of the price of the competition for reliability.

So much, then, for the background facilities to the eventual production flow. What of Rotax ideas for the production lines of a few years' time? The company have always maintained close relations with the aircraft and engine manufacturers, because it is upon these contacts that the next stage of systems design is decided. The process of advancement is, in fact, not very clear cut, as engine, airframe and accessory designers all have a contribution to make. At the moment, too, electrical manufacturers are at a crossroads with many lines of development to pursue ahead of them. It is not easy to recall when there has been such a wide divergence of opinion about the best way to generate aircraft electric power—notably constant frequency A.C., which continues to challenge the ingenuity of designers in achieving low weight and high efficiency over a speed range now generally stipulated as about 3/1.

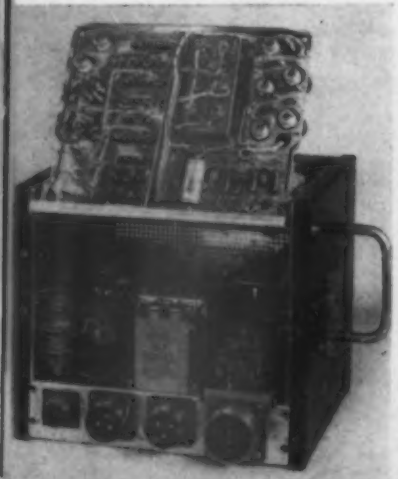
Assuming that there is a requirement for a supply of constant frequency A.C., it can be met by a Sundstrand constant speed drive and alternator, by other types of hydro-mechanical drive (such as Hobson's 15kVA constant speed unit), by a hydraulic drive—which may be remote from the powerplant—or by an A.P.U. or an air turbine drive. The number of manufacturers involved in developing these schemes results in a bewildering array of component permutations. English Electric, for example, offer a complete system of their own (Sundstrand drive) or work in conjunction with Rotax; Hobson with B.T.H., and Rotol with other manufacturers again. Competition for the few British civil orders is becoming very intense, particularly since the challenge of foreign manufacturers' work must be taken into account. On exported equipment this is a powerful force with which to reckon. Rolls-Royce Conways exported to the U.S. for example, will carry certain U.S. AiResearch equipment, and U.S. Westinghouse equipment is to be used on Fairchild-built Fokker Friendships.

Presumably Conways for the VC.10 will be equipped with British accessories (the English Electric Sundstrand seems a likely choice) but Armstrong Siddeley are building AiResearch A.P.U.s and starters under licence; Rotax are supplying generating equipment for the Fokker-built Friendship with magnetic amplifier control chosen on technical merit over the more bulky transformer rectifier unit; Rotax generating equipment is to be used on the Grumman Gulfstream and is also used on the Vanguard.

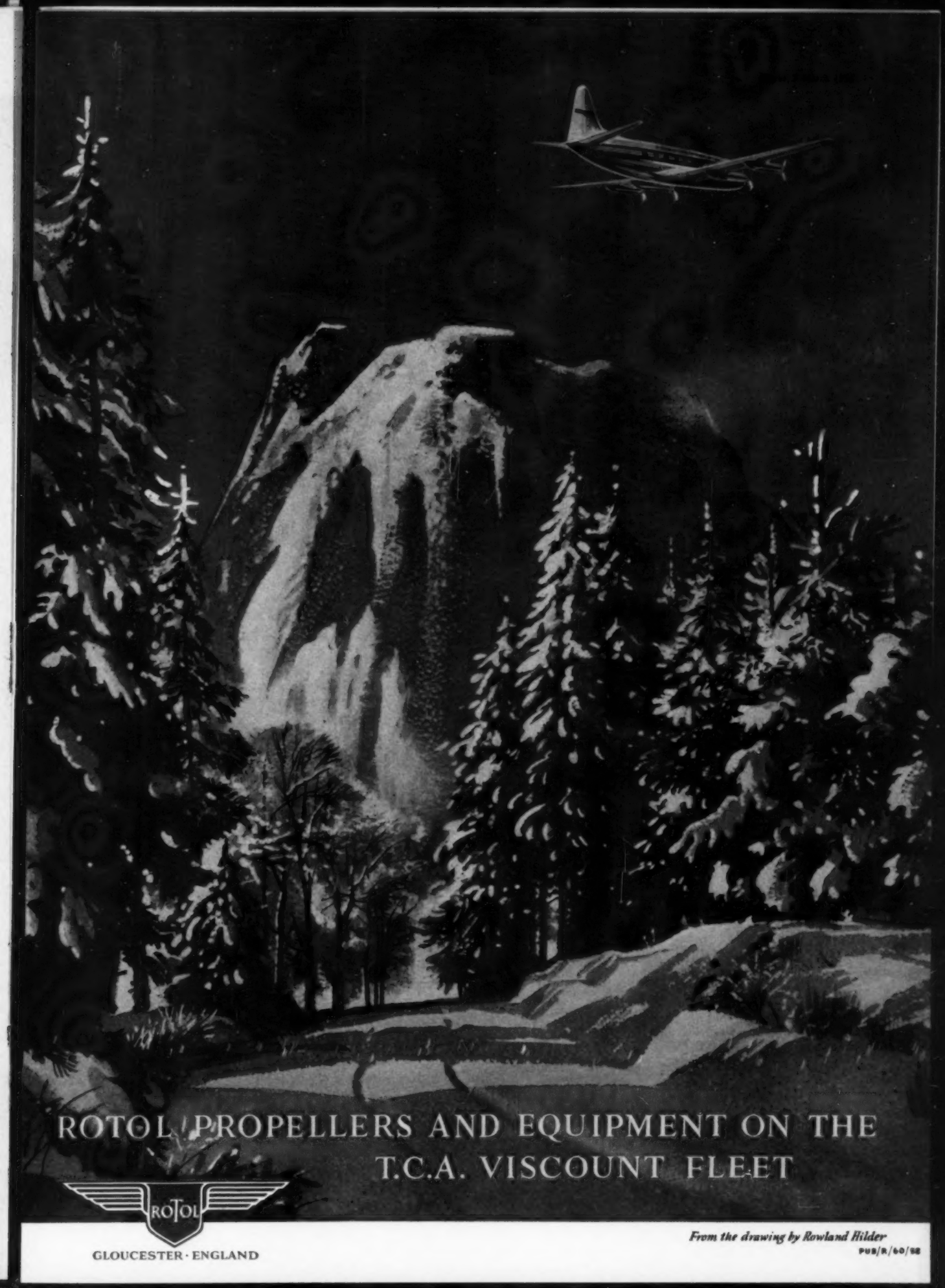
These examples show very clearly the competitive pattern that is forming. It represents a healthy fresh wind throughout the industry, but which only the robust may long survive.

To the rival schemes for constant frequency A.C. generation may be added a new Rotax suggestion for a self-contained variable speed, constant-frequency alternator. It is one of the difficulties of the accessory manufacturer's life that he must sell equipment at the scheme stage if he can; a longer wait to prove a unit or an idea may allow the competition to get too far ahead. Development of this particular scheme (briefly described in *Flight*, January 31, 1957) is now being continued "behind closed doors," as certain difficulties have been encountered in obtaining competitive efficiencies with 60 and 80kVA units throughout the speed range. The principle is a Swedish one, and has been satisfactorily demonstrated on a 750W unit; for the moment, no more may be said.

Another competitor in the constant frequency alternator market is the French firm Labinal, whose alternator and drive is to be used (for example) on the six Caravelles for the Scandinavian Air-



A small Rotax magnetic amplifier unit is used on the F.27 rather than a more cumbersome transformer-rectifier unit.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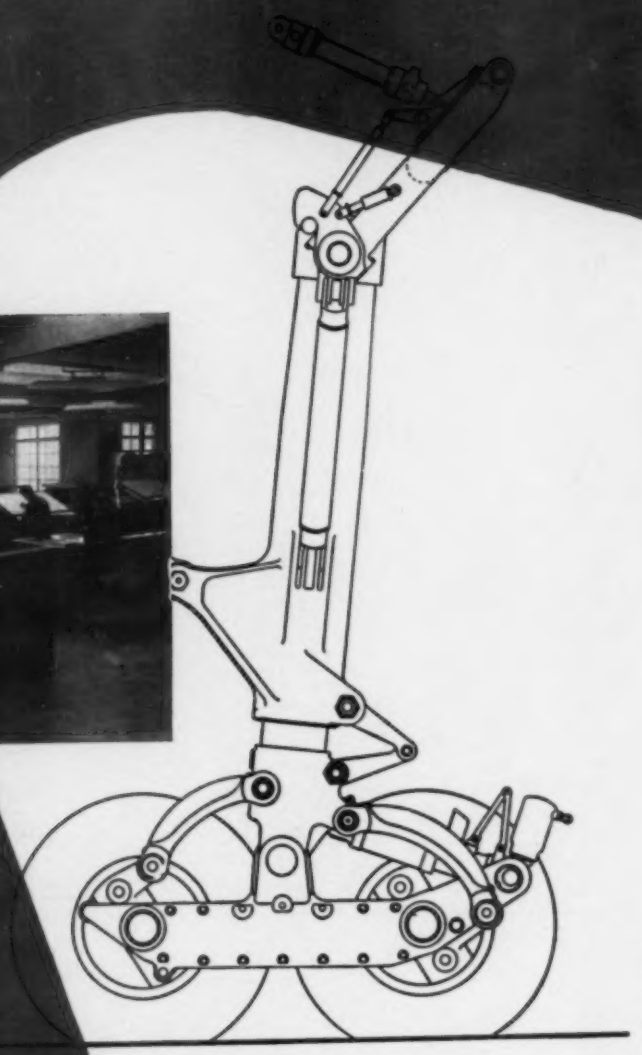

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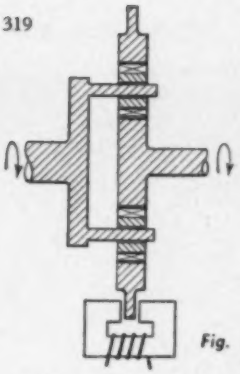


Fig. 7. (Above) Air bearing.

Fig. 5. (Left) Labinal magnetic constant speed gearbox.

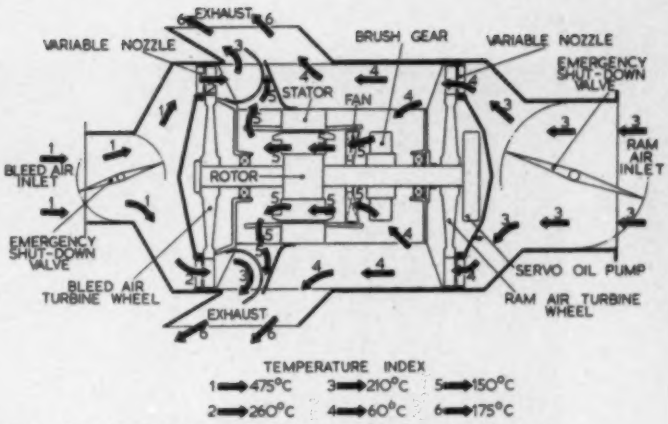


Fig. 6. An alternator driven by both ram air and engine bleed air develops its full output in all conditions of flight.

ROTAX LOOKS AHEAD . . .

lines System. This firm uses a function of alternator output to brake magnetically the annulus ring gear of an epicyclic gearbox, and so obtain a constant speed gearbox output (see Fig. 5).

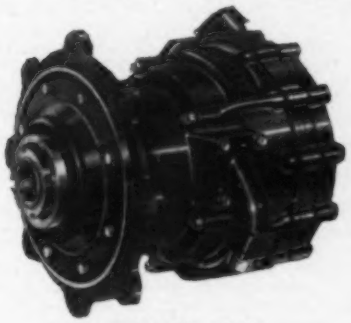
In Britain, Rotax are doing a great deal of work upon constant speed bleed or ram-air turbine drives, which some engineers believe are the ultimate answer to the constant frequency alternator problem. For the moment, although they can be closely governed, their efficiency is rather poor. There have also, in the past, been one or two rather serious incidents as a result of the turbine wheel bursting, and the U.S. Civil Aeronautics Administration has specified that the wheel must fail-safe if turbine drives are used.

Experience at Rotax has been that, although turbine wheels may shed their blades, all have so far been contained within the casing or entered the silencer through the exhaust air pipe. But they admit that they may have been lucky, and are now engaged in the development of a "frangible wheel"—something with the shattering characteristics of a toughened glass windscreen, where the fractured particles are all small enough to have a low momentum.

An instance of the urgency of this work is a requirement for air turbine starters on military aircraft that, should the pressure-reducing valve in the engine-bleed-air line jam open (it is assumed that the first engine of a multi-engined installation is started electrically or by combustion starter) the sortie must not be aborted. This means that the turbine, instead of being subject to air pressure at 30 lb/sq in for a few minutes, may well be subject to 80 lb/sq in for several hours.

The air pressure reducing valve is clearly an important item of equipment; Rotax now make their own which has proved successful. As a fail-safe measure it requires an electric current to open it and is loaded into the closed position. It can operate in a temperature of 450 deg C.

The major problems of an integral air turbine-alternator unit running at 24,000 r.p.m.—bearing and centrifugal stresses—have been overcome to the extent where a 15kVA two-pole machine (for example) is an entirely practical unit, with an adequate overhaul life. One advantage of this combined unit is that it is possible to save some 15 or 20 lb weight on a gearbox or shafting. A promising approach to the air turbine problem is to use both ram-air and bleed-air to drive the alternator, with a control system that meters bleed-air only when the ram-air variable nozzles are adjusted for maximum flow. The advantage of a small bleed-air requirement during cruise is apparent. Such a scheme is shown in Fig. 6.



Rotax air turbine starter.

Some useful work has also been done on air-lubricated bearings, an example of which is shown in Fig. 7. The bearing is a loose fit in its housing and floats on a cushion of air. But no air bearing works well under high g loadings because the non-viscous film breaks down; the solution proposed is a layer of molybdenum disulphide lubricant on the outer race and the inner face of the housing. This type of bearing has been remarkably successful on test. Normally, spring-loaded angular-contact bearings are used in the rotating assembly of an air-turbine drive, lubricated by an air force-fed plunger pump.

Perhaps the most encouraging experience of air turbine-driven alternators results from the development effort that Rotax have put into control techniques. A mechanical governor to adjust the stator nozzles can be used where control to within ± 5 per cent is adequate. But for close control of constant frequency supply, a magnetic amplifier servo control is used that governs to within $\pm \frac{1}{4}$ per cent in the steady state and $\pm 2\frac{1}{2}$ per cent in the transient condition, with a return to close control within one second.

Present development is concerned with paralleling the output of two or more air turbine-driven two-pole alternators, and Rotax are experimenting with techniques that have not been used previously elsewhere; to a certain extent the air turbine is used as a vehicle for investigation into the parameters of protection, control and alternator matching.

The "soft drive" characteristic of the air turbine-alternator can be stiffened electrically by "doctoring" the output transformer current and using the mag-amp servo as an anticipatory device, and a tacho-generator is used to compare the alternator voltage and keep paralleled machines in phase; load sharing is by a comparison of current components through paralleling networks.

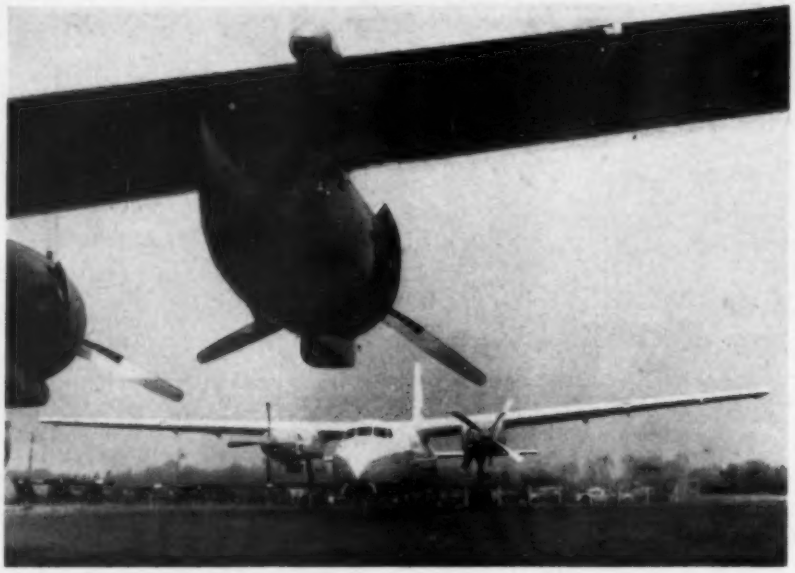
Glancing again over the whole field of alternator drives, the position might be summed up in the following way: the variable speed, constant frequency alternator is probably the ideal if its efficiency can be maintained over the necessary 3/1 speed range. The air turbine drive is promising and might be the best eventual solution. But serious work on paralleling is still at an early stage, and the weight penalty of such an air turbine drive in additional fuel required to compensate for the air bled from the engine is regarded by some engine manufacturers as putting the scheme out of court. Hydraulic constant speed drive is practical for any size of alternator—Rotax and Joseph Lucas (Gas Turbine Equipment), Ltd., have teamed up on this development—and has the advantage of being well suited to remote operation. The overall efficiency is comparable with other constant speed drives.

The hydro-mechanical drive is quite practical and many are in service, but has to be most carefully made and scaled to match the alternator size. With large machines in very high speed aeroplanes there may be overheating problems. The fuel sink can be used, of course, but there is a growing reluctance to advance this as an automatic panacea for all cooling ills. Finally there is the electro-mechanical Labinal drive, to which similar remarks about cooling may possibly apply.

Any review of Rotax activities would be incomplete without reference to their service and after-sales organization, of which they are particularly proud. Sound arguments can be advanced for a very much more liberal attitude by British designers and operators towards a "dispose at overhaul" policy for small components and much more standardization for large ones: Rotax, for example, manufacture no less than 285 different actuators, and are required to carry enormous and uneconomical stocks of spares, overhaul manuals and so on. However this may be, the manpower needed for customer liaison is fairly considerable. Rotax parallel the largest aircraft and engine manufacturers in the organization of their servicing arrangements; Lucas-Rotax have a large organization in Canada, a spares depot is being established in New York and joint arrangements are being made for the handling of Rotax units through various agents across the world. As a matter of course, engineers are made available at very short notice to firms developing Rotax-based electrical systems.

Commercial survival within the aircraft accessory industry of the next few years must depend upon very much higher standards than those adequate in previous years. The stimulant of close competition should improve the product—by accelerating its birth-pains, hastening its development, extending its overhaul life and the service that goes with it. This article has tried to show the research and development background of one firm that realizes the challenge is upon them now.

A.T.P.



This "Flight" photograph of the Handley Page Dart Herald was taken last Monday at H. P. Woodley, where the aircraft—converted from the first piston-engine prototype—was rolled out for imminent flight-testing after its eight-month refit. The Alvis powerplants in the foreground belong to the second Herald.

CIVIL AVIATION

PROFIT FOR B.O.A.C.

WHEN the chairman of B.O.A.C., Sir Gerard d'Erlanger, presented his Corporation's accounts for 1956-57, he hinted at a possible deficit in this current year. At the same time, it will be recalled, strong words were said about the effect of the Britannia's troubles on the Corporation's future results.

It now seems that, in fact, B.O.A.C. will wind up their 1957-58 accounts at the end of this month with a profit of about £250,000. This is cheerful news, especially in view of the Minister of Transport's recent statement that B.O.A.C. were not likely to have a successful year.

The profit is only a very little less than that achieved by B.O.A.C. last year (when, incidentally, Mr. d'Erlanger had forecast a deficit of £1½m); and it does appear to vindicate the Britannia, which is understood to have made a substantial profit.

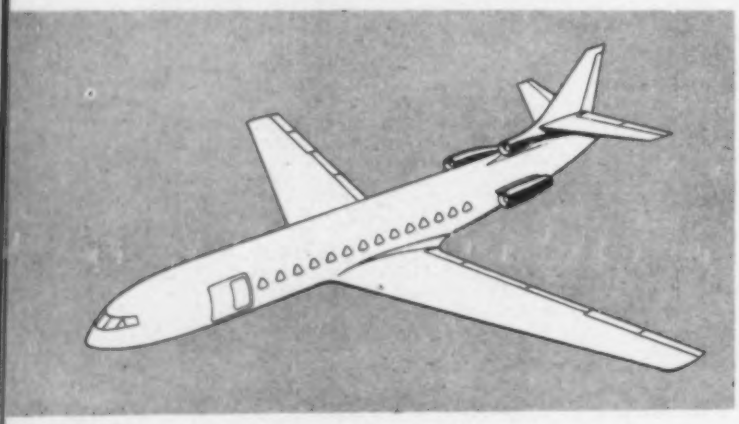
A move by B.O.A.C. to fly the long-sought trans-U.S.S.R. route to the Far East was signified last week by a formal request to the Government for the opening of negotiations.

B.E.A. SPEAKS ABOUT JETS

THROUGHOUT the wrangling which finally led to conditional Government approval for B.E.A.'s order for D.H.121s, the Corporation made no comment (excluding a brief remark or two by its chairman) until last week when Lord Douglas disclosed some of the Corporation's thoughts on the D.H.121 order. Points from his remarks are summarized as follows:

"Traffic on many of the shortest short-haul routes—under about 500 miles—will probably continue to travel for a long time in the more economic and operationally flexible turboprop aeroplane." But, he said, on routes of 500 to 1,200 miles, and on the more highly competitive ones of under 500 miles—"where jets may have to be introduced in spite of the operational arguments against them"—short-haul jets were going to be "essential." Lord Douglas disclosed that the D.H.121 would weigh about 120,000 lb and carry 100 high-density passengers for 1,000 miles.

Remarking on the Corporation's results for January, Lord Douglas records that traffic during that month was ten per cent short of the amount budgeted for. A loss of more than £600,000 has been made—"an unpleasant reminder of our steadily worsening seasonal traffic problem." However, Lord Douglas gave no indication that his previous estimate of a £1 million profit for the whole B.E.A. year might not be attained.



PASSENGERS RATHER THAN BOMBS

WHEN told of the agreement reached by Lord Douglas of Kirtleside and Marshal Zhigarev on the London - Moscow air service, Mr. Kruschev is reported to have remarked: "It is better to fly passengers to London than bombs." This message, comforting to Londoners, was appropriate at a time when summit talks appeared to be as elusive as ever.

But there is still much to be done before the coming autumn sees the London-Moscow route opened to passengers. An operational stumbling block is noise: the Tu-104 has not yet satisfied British authorities on this count. Rather than allow this factor to delay inception of the service, it is probable that Aeroflot would use the turboprop Il-18 *Moscow*. The Russian turbojet will beat the Viscount by about two hours on the London - Moscow route, and range-limitations might force the British aircraft to make an intermediate stop at Copenhagen, whereas the Tu-104 could fly non-stop. B.E.A.'s difficulty will be solved when their six Comet 4Bs are delivered late next year.

Another problem awaiting solution is the negotiation of traffic rights. Lord Douglas was quoted as saying on Moscow radio: "The new service will not affect the interests of S.A.S., whose aircraft carry passengers between Moscow and Copenhagen. Passengers using the Moscow - London service will only touch down at Copenhagen."

Nevertheless, it has been reported that there remains some doubt as to the terms on which the Scandinavian governments will allow Aeroflot to use Copenhagen. B.E.A. are not seeking traffic rights there, but Aeroflot's position will depend on whether their service is operated non-stop to London, or as an extension of their present one to Copenhagen. In the latter case S.A.S. could presumably press for a compensating extension of their own service beyond Moscow.

The agreement reached between Lord Douglas and Marshal Zhigarev is essentially inter-line in character, and not to be confused with the bilateral U.K.-U.S.S.R. air transport agreement signed last year by Marshal Zhigarev and the Rt. Hon. W. D. Ormsby-Gore. The latest agreement concentrated on the operational aspects of the new service, and *inter alia* provided for a Soviet technical mission to visit the U.K. later this month. The British party of B.E.A. and M.T.C.A. officials returned from Moscow last week with some reservations about the technical progress made. Plenty of co-operation (and hospitality) was apparently extended by the Russians; but when there is almost complete lack of knowledge about each other's methods, detail-discussions tend to be long drawn-out. No doubt some of the loose ends left in Moscow will be tied up during the forthcoming return visit by the Russian team.

Schedules envisage both airlines making two flights weekly in each direction. Flying times between London and Moscow will be six hours for B.E.A.'s Viscount 806 and four hours for the Tu-104. The return fare is to be £142 8s.

From the magazine "Air-BP" comes this impression of the originally projected Caravelle powerplant arrangement, which was based on three Atar turbojets. Comparisons with the D.H.121 and Bristol 200 are intriguing (see "Straight and Level," page 315).

News of TACA ViscountExperience

Ricardo H. Kriete, President of TACA International Airlines, announced recently in San Salvador that in the first six weeks of operation over its routes the Vickers Viscount has shown encouraging traffic trends.

'On certain routes the load factor has been as high as 86%. The load factor over all routes on which the company operates the Viscount schedules has been 73%. Passenger reaction in our area has been most enthusiastic for the new jet-prop aircraft', said Mr. Kriete.

Passenger-appeal is often considered intangible. In the Vickers Viscount it is a conscious feature of design, based on experience. Peace of mind as well as physical comfort have been translated into practical terms, and independent studies have shown that Viscount passengers experience less fatigue than other air travellers. Built-in ease of maintenance speeds turn-round and avoids the irritation of airport delays.

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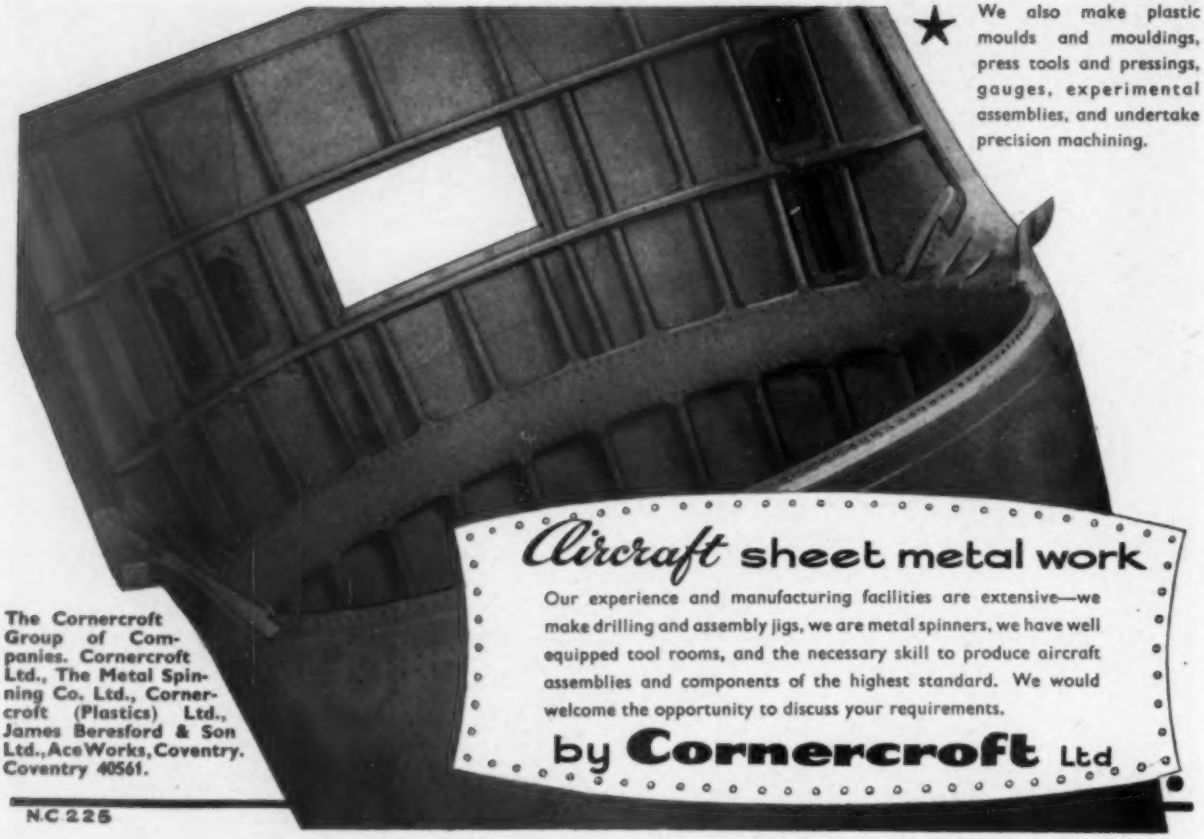

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CIVIL AVIATION . . .

DELIVERING THE NEWS

A SWEDISH correspondent has contributed an interesting picture of Linjeflyg, the Stockholm non-scheduled airline, formerly known as Airtaco.

Every day, whether in winter blizzard or short summer sunshine (he writes), the silver and blue DC-3s of Linjeflyg take off from Bromma Airport near Stockholm on what is believed to be the largest newspaper airlift in the world. 160,000 copies are flown every day to eight domestic airports, from Malmö in the south to Nordmaling in the north.

Last year, Linjeflyg carried 8,950,000 lb of newsprint and 22,090 passengers in their fleet of eight DC-3s (two of them chartered from S.A.S.), four Lockheed Lodestars and one Lockheed Electra. These aircraft come from all corners of the earth. One of them, SE-CBX, was until recently transporting cattle in Mexico; and SE-CAZ took part in the recent Indo-China conflict.

The airline's personnel includes 18 pilots, 16 co-pilots, six flight engineers, four male and four female cabin attendants (with 12 more hostesses in training). Fifty mechanics and six radio electricians keep the aircraft in running order.

Linjeflyg is owned half by S.A.S. and half by the two evening newspapers which employ this daily airlift. The directors are Carl-Henrik Hölfjors and Sven Ostling.

The most colourful flight links Stockholm with Sundsvall and Nordmaling, a town of 900 inhabitants located between Umeå and Ornsköldsvik in the north of Sweden. On a typical day at noon, two newspaper lorries back up against the rear door of the waiting Linjeflyg aircraft. In 30 minutes a human chain has transferred the bundles into the aircraft, where they are piled knee-deep, to a payload limit set at 7,000 lb.

The first stop is made at Sundsvall where a specially-built stainless steel platform with canvas roof is pushed against the rear door. The newspaper distributors transfer the bundles to their delivery vans and within a few minutes are speeding on their way to the news-stands. This operation is repeated on a smaller scale at Nordmaling. The return flight carries passengers, a few from Nordmaling to Sundsvall, a full cabin during the last leg of the journey back to Bromma.

The flying crews have behind them a long and varied experience. Ulf Christiernsson, a veteran pilot with over 12,000 flying hours, did night mail runs on Junkers in pre-war years, was for six years with the R.A.F. in North Africa and Sicily, then went with Swedish Airways to the Middle East and finally spent four years with El Al before joining Linjeflyg. The majority of this airline's pilots received their training in the Swedish Air Force.

Linjeflyg's crews carry out a wide range of charter flights. Thorvald Andersson was the last pilot to land at Budapest with drugs and penicillin for the Freedom Fighters on behalf of the Swedish Red Cross, while Soviet tanks were closing in. And Folke Höök recently flew 800 lb of live fish in the floats of a Hawker Osprey from the Lapland streams to Gällivare.

Newspapers being off-loaded through the rear door of a Linjeflyg DC-3 at Sundsvall (see "Delivering the News").

COMPETITION WITH A VENGEANCE

IT is probable that a fourth carrier will soon enter the busy route between New York and Bermuda. On May 1 Eagle Airways (Bermuda), Ltd., a recently formed subsidiary of Mr. Harold Bamberg's lively British independent Eagle Airways, Ltd., plan to inaugurate Viscount operations on this service at an initial weekly frequency of seven flights in each direction.

Eagle Airways (Bermuda) will have to compete with no less than three powerful, well-entrenched rivals. PanAm have been flying this route since 1937 (original certification having been based on consideration of it as the initial sector of PanAm's proposed transatlantic service). P.A.A. appear to regard it as important, and waste no time introducing their most superior equipment into service between New York and Bermuda. Eastern Airlines moved in when they absorbed Colonial Airlines in 1956, and now operate a daily New York - Bermuda service with Super Constellations, and weekend services between Washington and Bermuda with L.749s. The third carrier is B.O.A.C., who (in association with their wholly-owned subsidiary B.W.I.A.) offer Viscounts on a daily service between Bermuda and New York, and on a further three flights a week from Trinidad to New York *via* Bermuda.

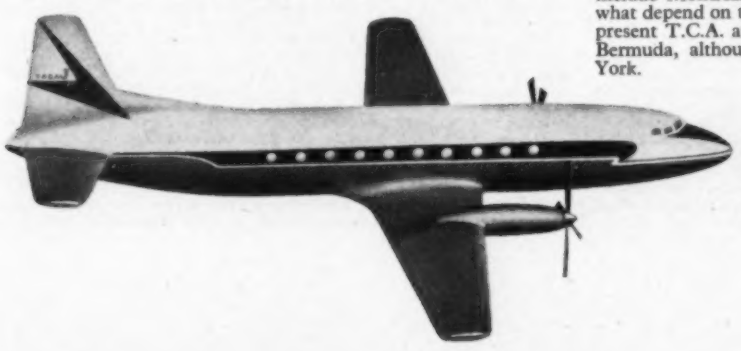
In recent years PanAm have consistently carried 50-60 per cent of total traffic between the U.S. and Bermuda. The respective shares of traffic carried by Colonial/Eastern and B.O.A.C. have fluctuated widely, but in 1956—the latest year for which complete figures are available—Eastern carried just over one-quarter and B.O.A.C. one-fifth of total traffic. In 1956 the steady post-war increase of air traffic was interrupted, the volume remaining at the previous year's level of about 165,000 passengers. But provisional 1957 statistics suggest that the upward trend has been restored with an annual increase of about 14 per cent.

The Bermuda Government has on various occasions expressed unhappiness about the policies of B.O.A.C. Ill-feeling arose when the Corporation withdrew the Bermuda - New York service in 1950 for a period of 14 months "owing to poor load factors." Unfortunately, this coincided with a campaign on the part of the island's Tourist Development Board to promote Bermuda as a holiday resort. Later there was some misunderstanding about whether B.O.A.C. would put Comets on this 763-mile route. In 1956 an action which caused further adverse comment was B.O.A.C.'s charter of a converted cargo DC-6A from Flying Tiger at a time when PanAm were placing DC-7Cs on the route. Throughout the period the Bermuda Government has been pressing B.O.A.C. to increase their flight frequency, and recent statements have implied a need for a minimum twice-daily service. The Corporation have no doubt been placed in an awkward position by these developments, for equipment restrictions have militated against the further provision of capacity on a route which is both highly competitive and operationally difficult to administer from the U.K.

A further factor to consider is the fear felt on the island that the development of Miami and the Caribbean (particularly the Bahamas) as a tourist area might result in the loss to Bermuda of the holiday traffic which is a vital part of the island's economy.

Seen against this background it is possible to understand the support given by the Bermuda Government to participation on this route by Eagle. Under the terms of the Anglo-U.S. Air Agreement, a second British carrier could be designated to operate between Bermuda and New York, but only now is that provision being exercised. The British Government has agreed to the designation of Eagle Airways (Bermuda), Ltd., and the C.A.B.'s examiner has recommended the granting of a certificate. Final Presidential approval is still awaited but no objections are expected.

Eagle will not only be faced with the prospect of severe competition but will also have some difficult operational obstacles to surmount. As planned at present, the operation will involve about 2,200 flying hours annually. Need to provide a reserve aircraft, and to maintain capacity for extra peak demand, suggests that two Viscounts will be allocated to this operation. A desirable increase in average utilization will be sought by extending services to include Montreal. Official Canadian reaction to this will somewhat depend on the result of the forthcoming general election. At present T.C.A. are the only carrier directly linking Canada with Bermuda, although Eastern offer competing services *via* New York.



Reports from Japan about plans to build a medium-sized turboprop are given substance by this photograph of a model of one projected design. Plans are at an early stage and no decision has yet been taken regarding powerplants, though Darts and Tynes have been considered. The aircraft may be built by a consortium of Japanese manufacturers.

CIVIL AVIATION . . .

AIRCRAFT ENGINEERS AND THE FUTURE

ONLY the highest possible standards of aircraft maintenance can be accepted in the British air transport industry. Any possibility that faulty engineering could pass undetected by the inspection screen is cause for grave concern. Yet this suggestion is made by the Society of Licensed Aircraft Engineers in the statement summarized on this page. They suggest that the remedy is for closer control over maintenance staff by increasing the dwindling number of engineers who hold S.L.A.E. licences.

IN a detailed statement of policy* published last week, the Society of Licensed Aircraft Engineers state the case for every phase of aircraft overhaul being the direct responsibility of licensed aircraft engineers. By implication, if not by direct assault, they attack the concept of "approved inspection organizations," upon which the majority of airline overhaul work in this country is based. Their main contention is that the "approved inspectors" who carry the responsibility for aircraft maintenance in a large organization, and the engineers who carry out the work, may possess no qualification of their technical and legal knowledge. A national standard of qualification, say the S.L.A.E., is "particularly necessary in a branch of engineering in which human lives are held in slender balance between the correct and faulty performance of even the apparently most trivial tasks."

In spite of past efforts by I.C.A.O., no real international agreement on the licensing of aircraft engineers has been forthcoming. I.A.T.A. concluded some while ago (mainly upon economic grounds) that complex individual engineer-licensing systems led to inefficient utilization of engineering staff. No individual licensing of aircraft engineers is done in France, and in the U.S.A. a large body of C.A.A. inspectors is ultimately responsible for all maintenance. In this country L.A.E.s are becoming progressively fewer (there are now 3,457 U.K. licensed engineers, but of these only about 500 use their licences for maintenance work; for the remainder the aircraft engineer's licence is a useful job-getting qualification) and—apart from the flying clubs—most maintenance approval is performed by the A.R.B.-approved inspectors of approved organizations; a licensed engineer is required by law only to sign periodical Certificates of Maintenance.

As the S.L.A.E. is quick to recognize, approved organizations *can* function very safely and very efficiently (the Corporations, whose maintenance is performed in this way, boast of standards that are recognized as second to none: but B.O.A.C. and B.E.A. also have a higher percentage of L.A.E.s per aircraft operated than the independent operators, manufacturers, flying clubs, private owners and foreign airlines). But safety standards must be completely inflexible, and the approval of maintenance organizations, in the Society's view, may leave loop-holes for faulty work. "At the present time," runs their statement, "too much is left to chance. Standards within any given company can be subject to severe commercial pressure, particularly in the employment of staff. It takes a very strong chief inspector to refuse approval to an inspector when the company (the chief inspector's own employer) has strong commercial considerations at stake and when the power to make the decision rests solely with the chief inspector.

"Although difficult to prove, because engineers aware of the facts are afraid of victimization and will not substantiate the evidence in writing, there are but few senior members of the S.L.A.E. who are not well aware of the shortcomings of certain approved inspection organizations, the general fall in standards of workmanship within many operating companies in recent years, and the number of aircraft accidents that nearly happen, or could easily have happened, because of faulty engineering."

The tenor of this statement leaves no doubt that the S.L.A.E. believe that the approved organization system can be subject to dangerous abuse. Their uneasiness is increased by the poor recent showing of candidates for engineers' licence examinations. In a recent period of twelve months, of 372 engineers who were examined, 230 failed, and of those who passed, 74 were employed by the Corporations, 36 were foreign students and the remaining 32 were employees or students from the whole of the remainder of the aircraft operators. The Society conclude that the *general* standard of aircraft maintenance engineering knowledge is on the wane; partly because of the adaptation of "production-line" techniques to aircraft maintenance and a resultant specialization of duties, partly as a result of lack of basic training for shop-floor workers and a dilution of skill with the addition of men from other industries, and partly because trade union demarcations prevent men gaining all-round experience. Restoration of the licence as a qualification of fitness and promotion, say the S.L.A.E., would be a nationally recognized proof of competency and would resuscitate individual responsibility.

The Society's council makes the following recommendations:—

(1) The aircraft maintenance engineer's licence should be recognized as a qualification, and not solely as an instrument of airworthiness control.

(2) "Basic" licences should be introduced in the "A" and "C" categories, additional to the existing "type" licences in these categories.

(3) Certification of the rectification of defects should be restricted to licensed aircraft engineers holding appropriate "type endorsements" from the A.R.B., or "type approvals" from the chief inspectors of approved inspection organizations.

(4) "A" and "C" licensed aircraft engineers should no longer be required to have intimate knowledge of the construction of "sealed" components, knowledge of their functioning as parts of the system in which they are embodied being sufficient for the proper discharging of the duties of such L.A.E.s.

(5) The "type" licensing system should be made, once more, universally applicable by examination to all aircraft, with the abandonment of temporary arrangements such as those made to licence certain engineers upon the Britannia.

(6) The "X" (electrics) and "X" (instruments) categories should be divided into "maintenance" and "overhaul" parts; an electronics category should be introduced and all ancillary categories . . . re-designated.

(7) The A.R.B.'s proposals for master licences should be integrated with those of the S.L.A.E. for basic licences (see No. 2 above).

(8) Additional privileges should be granted to corporate members of the S.L.A.E. in relation to the acquisition and extension of licences, especially as regards reduction . . . of the experience requirements.

(9) The practice should cease of removing "type" endorsements upon licences, as aircraft, engines, etc., are taken off the British civil register.

(10) The Independent operators, acting severally or collectively, should introduce apprentice, basic and type training schemes to parallel those of the two national corporations.

* * *

First reaction to the S.L.A.E.'s statement reflected public discomfiture that any aspect of British aircraft maintenance should be held in question; and particularly that charges of "faulty engineering" should be levied by a body with the knowledge and insight of the engineer's society. But comment from operators with approved maintenance organizations was cautious and reserved. The British Independent Air Transport Association said that they were studying the report, but could not comment until their members had met for discussion. B.E.A. had no comment to make, and B.O.A.C. said only that "The general standards of aircraft maintenance in the United Kingdom today are at least as high as, and in the majority of cases probably higher, than in any country in the world. There is no disagreement between this statement and the Society's report that the effectiveness of British airline engineering is second to none."

The following statement of opinion has, however, been obtained from the British Air Line Pilots Association, to whom we offered our columns for an expression of their views:—

"The British Air Line Pilots Association supports the S.L.A.E. Statement of Policy on the licensing of aircraft engineers and also supports the resolution of the International Federation of Air Line Pilots' Associations relating to approved organizations. I.F.A.L.P.A. has stated that accidents could be caused by failures of responsibility of personnel within an approved organization and, therefore, the abolition of ground engineers' licences must be opposed.

"One of our principal objections to such organizations concerns mistakes made by an unlicensed member of a maintenance department. If a mistake is made, it is most difficult for investigators to trace the culprit, whereas a licensed engineer, whose responsibilities are clearly defined, could lose his licence through negligence.

"This is not just comment for the sake of comment, because pilots, as individuals, are required to have certain licences and qualifications and are, therefore, liable to account for their actions at all times.

"Pilots are not members of an approved organization (in this case the aircrew section of a company) which suggests that it is illogical to have those entrusted with maintenance on a different basis of responsibility from that of pilots . . .

"Apart from the comparative responsibilities, there is the simple evidence of serious defects which have occurred after a certificate of maintenance has been issued; defects which were attributable to the mistakes of an approved organization. Even if a serious defect occurs through a material fault, then the rectification of the defect need not be undertaken by or under the direct supervision of a responsible licensed engineer, providing the period of validity of the certificate of maintenance is unexpired. Those procedures are unacceptable in principle . . .

"The present structure of the approved-organization system is acceptable down to the level of the licensed engineer because every member of that structure is responsible, through his superiors, to the A.R.B. However, below that level the structure is weak and inconsistent with the responsibilities and standards from which it depends. The men who actually remove, repair, replace and inspect components are, for the most part, unqualified academically and their practical experience does not have to be submitted to an independent check.

"This comment is most applicable to maintenance away from an operator's principal engineering base. In practice, the principle of approved organizations has been accepted when the standards of maintenance and inspection are high—such as obtains at large engineering bases."

*"*The Licensing of Aircraft Engineers—Now and in the Future"; Society of Licensed Aircraft Engineers, 1 High Street, Maidenhead, Berks.*

COMMONS DEBATE INDEPENDENTS

IN the House of Commons last Friday Mr. Steward (Con., Stockport South) proposed, on a private Member's motion, that United Kingdom independent airline operators should be encouraged to expand in association with the Corporations. After a review of the independents' progress and problems, Mr. Steward concluded that Britain's present air effort was "totally inadequate," that the position would be improved by granting the independents more security of tenure, and that a commission of inquiry should be appointed to consider the best system for promoting the British air transport industry. Dr. Bennett (Con., Gosport and Fareham), seconding the motion, welcomed the growing co-operation between the Corporations and independents.

G/C. Wilcock (Lab., Derby North) was not aware of friction between the Corporations and independents. He was against the profit margin being the prime object of B.O.A.C. and B.E.A. Mr. Hobson (Con., Warwick and Leamington) felt that air freight should be encouraged. Birmingham's airport, Elmdon, might be developed to cater for freight. Mr. Mikardo (Lab., Reading) was critical of certain unnamed independents: some, he alleged, obtained certificates and then failed to operate the routes involved, thus keeping the Corporations off those routes; others, "while carrying out the statutory rules laid down by the A.R.B., do not break their necks to go beyond the minimum that is required."

Mr. Shepherd (Con., Cheadle) put the case for differential fares, and maintained that the turboprop should not be "pushed out . . . for the sake of speed." Mr. Chapman (Lab., Birmingham, Northfield) expressed sharp criticism of the services offered by Aquila and Channel Airways. [Spokesmen for these two companies have subsequently replied in strong terms.] Mr. Beswick (Lab., Uxbridge) thought that there might well be a case for a third major British airline, but saw no reason why it should be privately owned. He conceded the independents' need for security and stability.

Concluding the debate, Mr. Airey Neave (Joint Parliamentary Secretary, M.T.C.A.) suggested that simultaneous voicing of complaints that the independents carried either too much or too little traffic implied that the Government's policy "was not far wrong." The motion, together with an amendment that the independents' expansion should not be to the detriment of the Corporation, was approved.

LONDON HELIPORT PLANS

FEELING, no doubt, that Britain's helicopter industry is not receiving the operational backing it needs in order to sell its products, Westland Aircraft have announced plans to build a heliport in London as a private venture. This, it is understood, will be on a site at York Road, Battersea (in the industrial area near the power station). Approval for "immediate construction of a heliport" is being sought from the Minister of Transport and Civil Aviation. It will consist of a small landing platform connected to a parking area on the bank, an arrangement similar to that at New York. Westland feel that such a heliport will permit the necessary experience to be gained in anticipation of the economic multi-engined helicopter as a public-service proposition. They foresee a commercial demand in the meantime, though they do not expect to make the heliport run at a profit. The company emphasize that they do not intend their project to provide London with a permanent helicopter facility, but that it will be a means of providing the necessary experience which will permit London's ultimate heliport requirements to be formulated.

Three days after Westland's announcement came a statement from Rotorports, Ltd., announcing that this company (formed early in 1957 "for the purpose of developing and operating a central London site as a public heliport") had already applied to the London County Council and to the Ministry of Housing and Local Government for permission to provide "a large floating pontoon-type platform landing area" permanently moored in the Thames within only a few minutes of the West End and City. Negotiations, says Rotorports, are in hand with the Ministry of Transport and with the Port of London Authority, and are in an advanced state—so much so that the company hopes that their heliport may be in operation by late summer. Rotorports are also negotiating for a permanent riverside site which they hope to develop as a permanent heliport.

BREVITIES

THE Committee on Interstate and Foreign Commerce has urged the U.S. House of Representatives to consider the construction of an Antarctic civil airport at McMurdo Sound.

* * *

Aer Lingus has announced the appointment of Mr. A. J. Walls as assistant sales manager.

* * *

Eagle Airways have opened a twice-weekly Viscount service between Manchester and Frankfurt via Brussels.

* * *

The London-Warsaw service will begin on April 9, L.O.T. and B.E.A. each offering two return flights per week.

* * *

B.O.A.C. plan to employ Indian and Pakistani stewardesses, wearing national dress, on services between Beirut and Karachi, Calcutta or Colombo.

* * *

Discussions are continuing between Fokker and Saab regarding manufacture of the Friendship under licence at the latter's Linkoping works.

* * *

Last week it was stated that Viscount G-AOHO was the first foreign turboprop to be seen in Russia. This honour is, in fact, due to a sister-aircraft which visited Moscow in July 1956 before being delivered to Central African Airways.

* * *

A record number of 145 people attended the dinner of the Aerodrome Owners' Association in London on Thursday of last week. Mr. Charles Newton (A.O.A. chairman) presided, and the toast of "The Owners" was proposed by Sir Frederick Handley Page. Other speakers were Sir Gibson Graham, of the A.T.A.C., Mr. Airey Neave, Joint Parliamentary Secretary to the M.T.C.A., and Sir Gerard d'Erlanger, chairman of B.O.A.C.

Speed: Its Influence on Transport (continued from page 307)

speaker stressed the way in which increasing speeds had in fact been accompanied by sharp reductions in cost.

Because increases in the speed of surface vehicles seemed to have been limited by some artificial factors . . . it now appeared that the only medium in which speed could continue to increase was the air. Although the demand for faster aeroplanes was likely to go on there would be a whole lot of operations which could be better conducted by an aeroplane not necessarily in the top speed range. Up to now, speed increases in the air had—by improvements in the state of the art and by much labour—always been accompanied by better economies and efficiency. Any reversal of that trend would be a setback for civil aviation and would halt the present flow of mass travel towards the aeroplane. Speed improvements as between aeroplane and aeroplane must be related to the job in hand and also to the economic "rate for the job." Speed by itself, and for its own sake, could be a false god, and pursuit of it was unhealthy.

Sir George then discussed the general speed trends for various types of aircraft. Noting that "an entirely new slope of curve has come about with the advent of the supersonic airframe," it was possible to predict bomber speeds in 1965 of Mach 2.5. Propeller-driven transports were not expected to exceed speeds of 500 m.p.h. The speed trend for jet transports was less easy to predict: "It seems to me that the subsonic jets such as the Boeing and the Douglas and the others are in themselves going to produce something in the nature of a speed plateau, and I think the airlines' financial situation will stop them being replaced for some considerable time. . . . There is no reason why civil jets should not be in existence at supersonic speeds in the 1960s. I believe, however, the financial burden of depreciating the subsonic jets will alone make that impossible, and a supersonic jet in operation before 1970 is of academic interest only . . . I believe that the operating costs when the time comes will be within reasonable distance of the operating costs—as we know them—of the subsonic jets."

In conclusion, Sir George saw no reason why we should not have our own great stake in this new field of supersonic travel: "If it is true that we are not going on with a supersonic long-range bomber, then let us spend the money on a supersonic long-range transport. This should not be hampered by following the basic design for a specialized military application in which economy is not a major factor. Let us make a virtue of necessity and put our effort into an optimum civil aeroplane."

The first showing of the Shell film *High-speed Flight, Part 2, Transonic Flight*, followed the Presidential Address. A vote of thanks to Sir George Edwards was proposed by Dr. G. W. H. Gardner, member of Council, and seconded by J. R. Cownie, chairman of the Students' and Graduates' committee. Members and guests then adjourned to the Society's headquarters in Hamilton Place for a reception by the President and Lady Edwards (photographs at this meeting appear on page 296 of this issue).

Bound for M.R. duties over the South Atlantic and Indian Oceans, the last of eight Avro Shackleton Mk 3s for the South African Air Force takes off from Woodford, Cheshire, en route for its new home via R.A.F. St. Eval.

SERVICE AVIATION

Royal Air Forces and Naval Flying News

No. 33 Sqn. Standard

CURRENT holder of the Ingpen Trophy, awarded annually to the all-weather squadron recording the best air-firing in Fighter Command, No. 33 Sqn. is to receive its standard at R.A.F. Leeming on April 24. The presentation will be made by Air Chief Marshal Sir Philip Joubert, who was the squadron's first C.O. on its formation in January 1916.

As a home defence unit No. 33 flew B.E.s and F.E.s, operating from Yorkshire and Lincolnshire airfields against Zeppelins. It was disbanded in 1919 but reformed ten years later as a bomber unit, first flying Horsleys but then becoming the first squadron to operate Harts. During the last war, equipped with Hurricanes, it operated over the Western Desert and in Greece; then it received Spitfires and in 1944-45 served in European operations, after the war being based in Germany and then participating in F.E.A.F. anti-terrorist operations with Hornets. The squadron is commanded by W/C. N. Poole, a navigator, and at present flies Meteor N.F.14s but is shortly to re-equip with Javelins.

U.L.A.S. Annual Dinner

AT the University of London Air Squadron annual dinner in Imperial College on February 21 the C.O., W/C. N. Cameron, noted that ladies were present for the last time as the Fighter Control Flight had been disbanded in 1957 and said that the number of flying members had also been considerably reduced. However, the squadron itself had a five-year stay of execution by the economy axe and this respite it had already put to good use by winning the Hack Trophy.

Dr. J. F. Lockwood, the Vice-Chancellor, noting that sixteen members had taken regular commissions during the year and that for 23 places in the unit 161 undergraduates had applied, went on to challenge his fellow-guest the Secretary of State for Air to "pull something out of the bag." Mr. Ward, however, refused to anticipate his Parliamentary statement. He reaffirmed that as great a proportion as possible of the national income was being devoted to defence and that no R.A.F. Command would ever be entirely without manned aircraft of some kind. Bomber Command still formed the country's largest single contribution to the prevention of war; and the flexibility of manned aircraft would continue to be required for transport, for maritime patrol and for the reinforcement of overseas Commands.

The Bennett Trophy for the most promising pilot was presented to P/O. C. S. F. Pine, the Field Trophy for the best fighter controller to Miss M. O. Woodham and the Spencer Trophy for the best all-round member to Cdt. Plt. J. G. Soper.

Among many notable guests at the dinner were Marshal of the Royal Air Force Sir Dermot Boyle, the C.A.S.; Air Chief Marshal Sir Walter Dawson; Air Marshal Sir John Whitley; Air Marshal Sir Edward Hudleston; and Air Marshal Sir Douglas Macfadyen.

Transport Command Statistics

ON the occasion of Exercise Quickstep (reported last week), figures for Transport Command's Beverley and Comet activity were disclosed. The Beverley, in squadron service since March 1956, had logged 15,433 hours' flying up to January 31 this year; and the R.A.F.'s Comet 2s, delivered in June 1956, had by the same date flown 8,767 hr. The present strength of the Command, given by Air Marshal Sir Andrew McKee at the time of the exercise, is 24 Beverleys, ten Comets and 30 Hastings. Twenty Britannia 250s are on order.

Hull U.A.S. Dinner

WHEN Hull University Air Squadron held its annual dinner at the Guildhall, Kingston-upon-Hull, on February 25 the commanding officer, S/L. P. Dawes, said that the unit's future had been assured for the next five years at least; as he put it, "I am glad to say we have not been axed—but we have been chiselled a little." Meanwhile, the membership situation "could not be brighter"; establishment had been reached and applications were being turned away. S/L. Dawes thanked Blackburn and General Aircraft, Ltd., for their assistance and co-operation and excellent maintenance.

In his reply on behalf of the guests the chairman of Blackburn Aircraft, Mr. E. Turner, said that aviation was going to be of still greater importance in this country and he looked forward to the time when Hull University had an engineering faculty. This the Vice-Chancellor, Dr. Brynmor Jones, countered by saying that if the company—as a result of profits made from the Beverley and those "they might make from the NA.39"—were to offer the university £1m, he would be happy to start such a faculty.

Mr. N. E. Rowe, Blackburn technical director, proposed the toast to the university and Dr. J. H. Nicholson, a former vice-chancellor, replied.

IN BRIEF

Ten officers and thirty cadets from L'Ecole de L'Air—the French equivalent of the R.A.F. College—were due to spend yesterday and today at Cranwell on a reciprocal visit.

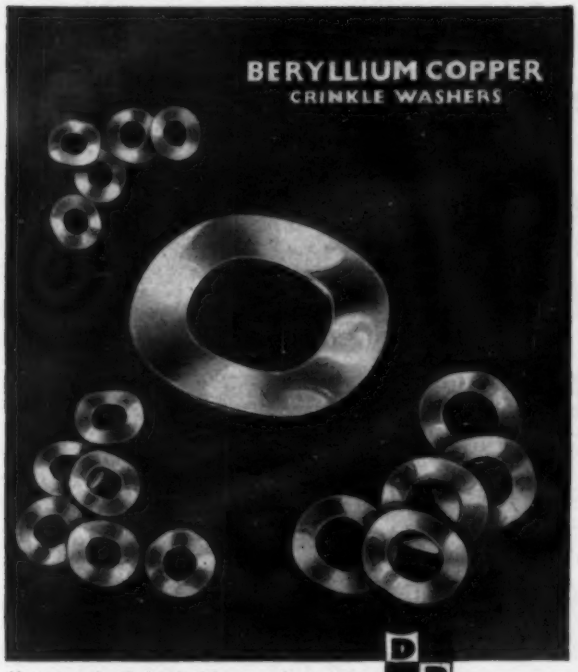
* * * * *

R.A.F. recruiting for January was the best since March last year. A total of 1,389 was recruited, against an average of 1,174 for the previous twelve months, and the number engaging for nine years or more—341—was the highest achieved in any month since the war.

* * * * *

Four Shackleton M.R.2s of No. 120 Sqn. are taking part in joint British-Canadian fleet exercises under the code name Maple Royal. Two of the aircraft have been visiting U.S. naval bases on the Atlantic seaboard and the other two are due to leave Aldergrove today (Friday) for Greenwood R.C.A.F. station, Nova Scotia.

High-level smiles in Bucks, Cyprus and "down under": Lady Boyle, wife of the C.A.S., presents a trophy to R.A.F. Halton staff who made two tons of toys for refugee children. Receiving it is W/C. C. R. B. Wigfall, with (l. to r.) Mr. R. H. Vaughan, P/O. W. J. Harker and Lt-Col. R. H. Wilson, U.S.A.F. (Centre) A. V-M. W. J. Crisham, A.O.C. Levant, greets A. Cdre. E. W. S. Jacklin, Royal Rhodesian Air Force C.A.S. and G/C. H. Hawkins, R.R.A.F., at Nicosia. (Right) A. V-M. C. D. Candy, new A.O.C. of R.A.A.F. Home Command (formerly S.A.S.O. of No. 3 Group, R.A.F.) with his S.A.S.O., A. Cdre. G. C. Hartnell, looking at a model of one of the recently purchased C-130s.



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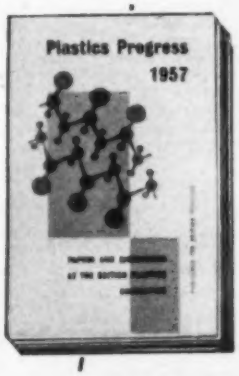

Full report of the fourth British Plastics Convention proceedings, including a complete text of the papers, together with a record of the discussions which followed them. The subjects covered are: Polyolefins; Polythene; Polyvinyl Chloride; Extrusion; Injection Moulding; Material Developments; Glass Reinforced Plastics. This authoritative survey of important branches of plastics technology will be valuable to all engaged in the science and industry of plastics.

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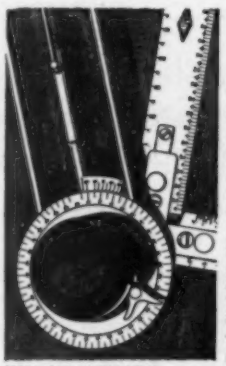

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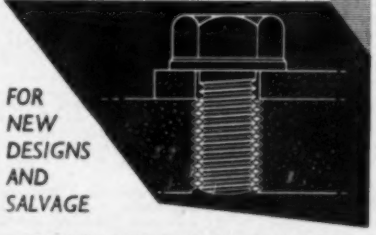

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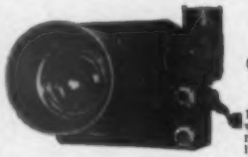

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THE AIR TRANSPORT ADVISORY COUNCIL give notice that they have received the undermentioned applications to operate scheduled air services:

FROM Eagle Airways, Ltd., of 40 Edgware Road, London, W.2, for the following Normal Scheduled Services to be operated with Viscount and Viking aircraft for the carriage of passengers, supplementary freight and mail at a frequency in accordance with traffic demand for ten years from date of approval:

APPLICATION No. 1636 for a service between London Airport or London (Blackbushe) and Lyons.

APPLICATION No. 1637 for a service between Manchester and Lyons.

APPLICATION No. 1638 for a service between London Airport or London (Blackbushe) and Tours.

APPLICATION No. 1639 for a service between Manchester and Tours.

FROM British Overseas Airways Corporation of London Airport, Hounslow, Middlesex:

(a) Application No. 1641 for a Normal Scheduled Service initially with DC7C aircraft and later with Britannia 312 and Boeing 707 aircraft for the carriage of passengers, supplementary freight and mail between London Airport and Paris (Le Bourget) at an initial frequency of two return flights weekly increasing later to seven return flights weekly for ten years from 1st April, 1958.

(b) For the following amendments to Normal Scheduled Services operated on Reserved Routes set out in Schedule "A," Part 1, to the Terms of Reference issued to the Council by the Minister of Civil Aviation on 30th July, 1952, and on other approved routes:

APPLICATION No. 1642 for permission to include optional traffic stops at Bombay and Colombo on Reserved Route No. 1.

APPLICATION No. 1643 for permission to include an optional traffic stop at Basra on Reserved Route No. 10 and on the route approved under Application No. 339 (London - Abadan and/or Karachi).

APPLICATION No. 1644 for permission to include an optional traffic stop at Detroit on Reserved Route No. 16.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [7650

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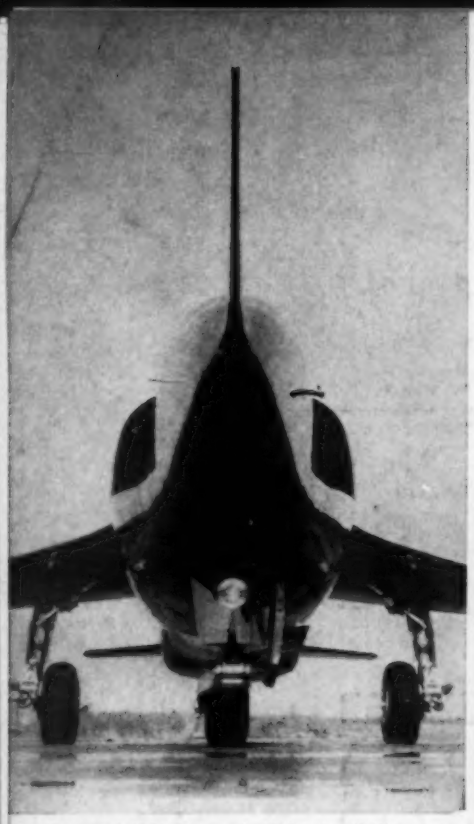
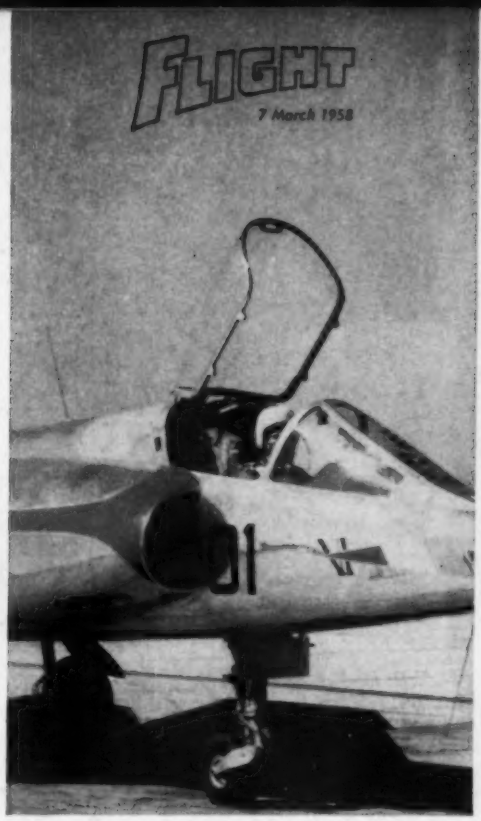


Breguet 1001 Taon. Anti-debris platforms below the intakes of the Breguet 1001 Taon do not interfere with air supply to the Orpheus at high angles of attack



Dassault Etendard VI. The Orpheus in the Dassault Etendard VI is mounted toward the rear of the fuselage, and its air intake is through cheek apertures

Fiat G 91. In the Fiat G 91, the rear-mounted Orpheus receives its supply of air from a chin-type intake, ducted below the pressurised cockpit

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The aircraft tested were:—

Fiat G 91 Dassault Etendard VI Breguet 1001 Taon	Now flying with ORPHEUS B Or 3
Dassault Etendard IV Sud Aviation Baroudeur	NATO production model offered with ORPHEUS B Or 12

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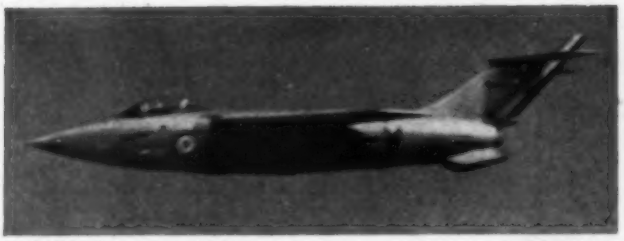
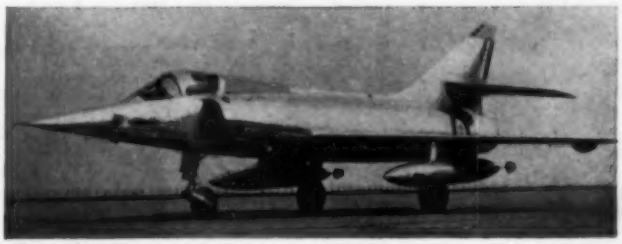


Sud Aviation Baroudeur PHOTO 'AEROPLANE'



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